

New Source Review Air Permit Application
Texas Gulf Terminals Inc.
Texas Gulf Terminals Project

Appendix B

Prepared By:

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1. EXECUTIVE SUMMARY

1.1. PROJECT BACKGROUND

Texas Gulf Terminals Inc. (TGTI) is proposing to construct, own, and operate a Deepwater Port (DWP), as part of the Texas Gulf Terminal Project, in Federal waters of the U.S. Gulf of Mexico located approximately 14 miles off the coast of North Padre Island in Kleberg County, Texas.

The purpose of the proposed project is to provide a safe, efficient and cost effective logistical solution for the export of crude oil from the United States of America (U.S.) to support the continued economic growth of the U.S.

The DWP terminal will include a Single Point Mooring (SPM) buoy system to moor a Very Large Crude Carrier (VLCC). The size of these VLCCs and inland port draft limitations prevent them from using the traditional docks at onshore terminals. Therefore, VLCCs have to be engaged offshore. The proposed SPM buoy system will be located in water with over 90 feet of depth, allowing a VLCC to be fully and directly loaded without the use of lightering (i.e., using smaller ships to transport crude oil from on-shore terminals out to VLCCs located in deeper waters).

The project will serve as a crude oil export facility with a capacity of 60,000 barrels per hour (bph) and 192 million barrels per year. The project will be able to load up to approximately 96 VLCCs per year. The proposed project is comprised of two major offshore components: the SPM Buoy system and the offshore pipelines. A detailed description of the SPM Buoy system components and the offshore pipeline system is provided in Section 4.

Per 33 CFR §148.3(d), The Environmental Protection Agency (EPA) is designated as cooperating agency to support the Coast Guard and MARAD in the review and evaluation of DWP license applications. Since the proposed project results in emissions of regulated pollutants, TGTI is submitting this permit application as part of the DWP license application to MARAD/USCG. TGTI has prepared the application on Texas Commission on Environmental Quality (TCEQ) forms based on guidance received from EPA Region 6. With this submittal, TGTI is proposing to authorize the Volatile Organic Compounds (VOC) and HAP emissions resulting from the loading of crude oil from the DWP Terminal onto a VLCC. Based on potential air emissions from the facility, the project will be subject to preconstruction review under the federal Prevention of Significant Deterioration (PSD) regulations since potential emissions of VOC will be greater than the 250 ton per year PSD major source threshold. A deepwater port is defined in 33 CFR 148.5 as follows:

Any fixed or floating manmade structures other than a vessel, or any group of structures, located beyond State seaward boundaries that are used or are intended for use as a port or terminal for the transportation, storage, or further handling of oil or natural gas for transportation to any State, except as otherwise provided in the Deepwater Ports Act of 1974, as amended, and for other uses not inconsistent with the purposes of the Deepwater Port Act, including transportation of oil and natural gas from the United States' OC; [...] Must be considered a 'new source' for purposes of the Clean Air Act.."

In addition to the loading operations, other ancillary sources such as engines and cranes located on the VLCC; and support vessels such as tug boats also result in emissions. As mentioned above, the DWP consists of the SPM buoy system that is used for loading of crude carrier vessels. Per the 1974 DWPA, the revised 2012 DWPA, and the DWP regulations (40 CFR 148.5), a DWP new source for purposes of the Clean Air Act is defined as "any fixed or floating manmade structure other than a vessel, or any group of such structures, that are located beyond State seaward boundaries and that are used or intended for use as a port or terminal for the transportation, storage, or further handling of oil or natural gas for transportation to or from any State...". Therefore, vessels are not

considered primary/direct sources of emissions from the Project for Clean Air Act new source review regulatory applicability. Per 40 CFR 52.21 emissions from the ancillary sources are secondary emissions and are not required to be included in comparison with the PSD major source thresholds. The secondary emissions are included in the source impact analysis submitted under separate cover. The proposed deepwater port source only triggers PSD permitting for VOC. The Federal New Source Review (FNSR) applicability is discussed in detail in Section 6.

Supporting documentation for this application is provided in the following sections. Included in Section 2 of this permit application is the required applicant information (including TCEQ Form PI-1 and Table 1(a)). The project location is discussed in Section 3, with an area map indicating the site locations. The process and project descriptions are provided in Section 4, including a process flow diagram and plot plan. Emission calculations are discussed in Section 5. FNSR applicability is covered in Section 6. The summary of Federal Best Available Control Technology (BACT) is provided in Section 7. The PSD air quality modeling and additional impacts analysis are addressed in Section 8. A review of general application requirements, including a federal and state regulatory applicability review, is provided in Section 9. Lastly, the permit fee and PE certification are addressed in Section 10.¹ All supporting calculations and data are included in the Appendices.

¹ Per guidance from EPA Region 6, there is no permit fee associated with a PSD permit application. TGTI has included the permit fee form in Section 10 to document no permit fee required.

2. APPLICANT INFORMATION: TCEQ FORMS

CORE DATA FORM

PI-1 FORM

TABLE 1(a)



TCEQ Core Data Form

TCEQ Use Only

For detailed instructions regarding completion of this form, please read the Core Data Form Instructions or call 512-239-5175.

SECTION I: General Information

1. Reason for Submission (If other is checked please describe in space provided.)		
<input checked="" type="checkbox"/> New Permit, Registration or Authorization (Core Data Form should be submitted with the program application.)		
<input type="checkbox"/> Renewal (Core Data Form should be submitted with the renewal form)	<input type="checkbox"/> Other	
2. Customer Reference Number (if issued)	Follow this link to search for CN or RN numbers in Central Registry**	3. Regulated Entity Reference Number (if issued)
CN 605490085		RN

SECTION II: Customer Information

4. General Customer Information		5. Effective Date for Customer Information Updates (mm/dd/yyyy)	
<input type="checkbox"/> New Customer <input type="checkbox"/> Update to Customer Information <input type="checkbox"/> Change in Regulated Entity Ownership			
<input type="checkbox"/> Change in Legal Name (Verifiable with the Texas Secretary of State or Texas Comptroller of Public Accounts)			
The Customer Name submitted here may be updated automatically based on what is current and active with the Texas Secretary of State (SOS) or Texas Comptroller of Public Accounts (CPA).			
6. Customer Legal Name (If an individual, print last name first: e.g.: Doe, John)		If new Customer, enter previous Customer below:	
Texas Gulf Terminals Inc.			
7. TX SOS/CPA Filing Number	8. TX State Tax ID (11 digits)	9. Federal Tax ID (9 digits)	10. DUNS Number (if applicable)
0802978324	32066715692		
11. Type of Customer:	<input checked="" type="checkbox"/> Corporation	<input type="checkbox"/> Individual	Partnership: <input type="checkbox"/> General <input type="checkbox"/> Limited
Government: <input type="checkbox"/> City <input type="checkbox"/> County <input type="checkbox"/> Federal <input type="checkbox"/> State <input type="checkbox"/> Other	<input type="checkbox"/> Sole Proprietorship	<input type="checkbox"/> Other:	
12. Number of Employees		13. Independently Owned and Operated?	
<input checked="" type="checkbox"/> 0-20 <input type="checkbox"/> 21-100 <input type="checkbox"/> 101-250 <input type="checkbox"/> 251-500 <input type="checkbox"/> 501 and higher		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
14. Customer Role (Proposed or Actual) - as it relates to the Regulated Entity listed on this form. Please check one of the following:			
<input type="checkbox"/> Owner <input type="checkbox"/> Operator <input checked="" type="checkbox"/> Owner & Operator			
<input type="checkbox"/> Occupational Licensee <input type="checkbox"/> Responsible Party <input type="checkbox"/> Voluntary Cleanup Applicant <input type="checkbox"/> Other:			
15. Mailing Address:	1401 McKinney		
	Suite 1500		
City	Houston	State	TX
ZIP	77010	ZIP + 4	
16. Country Mailing Information (if outside USA)		17. E-Mail Address (if applicable)	
18. Telephone Number	19. Extension or Code	20. Fax Number (if applicable)	
(832) 203 - 6400		() -	

SECTION III: Regulated Entity Information

21. General Regulated Entity Information (If 'New Regulated Entity' is selected below this form should be accompanied by a permit application)	
<input checked="" type="checkbox"/> New Regulated Entity <input type="checkbox"/> Update to Regulated Entity Name <input type="checkbox"/> Update to Regulated Entity Information	
The Regulated Entity Name submitted may be updated in order to meet TCEQ Agency Data Standards (removal of organizational endings such as Inc, LP, or LLC).	
22. Regulated Entity Name (Enter name of the site where the regulated action is taking place.)	
Texas Gulf Terminals Project	

23. Street Address of the Regulated Entity: (No PO Boxes)							
	City		State		ZIP		ZIP + 4
24. County							

Enter Physical Location Description if no street address is provided.

25. Description to Physical Location:	Site is approximately 14 miles offshore the coast of Texas, Southeast of Corpus Christi.						
26. Nearest City	N/A		State	TX		Nearest ZIP Code	N/A
27. Latitude (N) In Decimal:	27.4785		28. Longitude (W) In Decimal:	97.013453			
Degrees	Minutes	Seconds	Degrees	Minutes	Seconds		
27	28	42.6	97	00	48.43		
29. Primary SIC Code (4 digits)	30. Secondary SIC Code (4 digits)		31. Primary NAICS Code (5 or 6 digits)		32. Secondary NAICS Code (5 or 6 digits)		
4612			486910				
33. What is the Primary Business of this entity? (Do not repeat the SIC or NAICS description.)							
Offshore Marine Terminal							
34. Mailing Address:	1401 McKinney						
	Suite 1500						
	City	Houston	State	TX	ZIP	77010	ZIP + 4
35. E-Mail Address:							
36. Telephone Number			37. Extension or Code		38. Fax Number (if applicable)		
(832) 203 - 6400					() -		

39. TCEQ Programs and ID Numbers Check all Programs and write in the permits/registration numbers that will be effected by the updates submitted on this form. See the Core Data Form: Instructions for additional guidance.

<input type="checkbox"/> Dam Safety	<input type="checkbox"/> Districts	<input type="checkbox"/> Edwards Aquifer	<input type="checkbox"/> Emissions Inventory Air	<input type="checkbox"/> Industrial Hazardous Waste
<input type="checkbox"/> Municipal Solid Waste	<input checked="" type="checkbox"/> New Source Review Air	<input type="checkbox"/> OSSF	<input type="checkbox"/> Petroleum Storage Tank	<input type="checkbox"/> PWS
<input type="checkbox"/> Sludge	<input type="checkbox"/> Storm Water	<input type="checkbox"/> Title V Air	<input type="checkbox"/> Tires	<input type="checkbox"/> Used Oil
<input type="checkbox"/> Voluntary Cleanup	<input type="checkbox"/> Waste Water	<input type="checkbox"/> Wastewater Agriculture	<input type="checkbox"/> Water Rights	<input type="checkbox"/> Other:

SECTION IV: Preparer Information

40. Name:	Denise Rogers		41. Title:	Compliance Manager
42. Telephone Number	43. Ext./Code	44. Fax Number	45. E-Mail Address	
(832) 203 - 6493		() -	denise.rogers@texasgulfterminals.com	

SECTION V: Authorized Signature

46. By my signature below, I certify, to the best of my knowledge, that the information provided in this form is true and complete, and that I have signature authority to submit this form on behalf of the entity specified in Section II, Field 6 and/or as required for the updates to the ID numbers identified in field 39.

Company:	Texas Gulf Terminals Inc.	Job Title:	Compliance Manager
Name (In Print):	Denise Rogers	Phone:	(832) 203 - 6493
Signature:		Date:	6/26/2016

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Important Note: The agency requires that a Core Data Form be submitted on all incoming applications unless a Regulated Entity and Customer Reference Number have been issued and no core data information has changed. For more information regarding the Core Data Form, call (512) 239-5175 or go to www.tceq.texas.gov/permitting/central_registry/guidance.html.

I. Applicant Information		
A. Company or Other Legal Name: Texas Gulf Terminals Inc.		
Texas Secretary of State Charter/Registration Number (if applicable):		
B. Company Official Contact Information: (<input type="checkbox"/> Mr. <input type="checkbox"/> Mrs. <input checked="" type="checkbox"/> Ms. <input type="checkbox"/> Other:) _____		
Name: Denise Rogers		
Title: Compliance Manager		
Mailing Address: 1401 McKinney, Suite 1500		
City: Houston	State: TX	ZIP Code: 77010
Telephone No.: 832-203-6493	Fax No.:	
E-mail Address: denise.rogers@texasgulfterminals.com		
<i>All permit correspondence will be sent via electronic copies unless hard copies are specifically requested through regular mail. The company official must initial here if hard copy correspondence is requested.</i> _____		
C. Technical Contact Name Information: (<input type="checkbox"/> Mr. <input type="checkbox"/> Mrs. <input checked="" type="checkbox"/> Ms. <input type="checkbox"/> Other:) _____		
Name: Denise Rogers		
Title: Compliance Manager		
Company Name: Texas Gulf Terminals Inc.		
Mailing Address: 1401 McKinney, Suite 1500		
City: Houston	State: TX	ZIP Code: 77010
Telephone No.: 832-203-6493	Fax No.:	
E-mail Address: denise.rogers@texasgulfterminals.com		
D. Site Name: Texas Gulf Terminals Project		
E. Area Name/Type of Facility:	<input checked="" type="checkbox"/> Permanent <input type="checkbox"/> Portable	
For portable units, please provide the serial number of the equipment being authorized below.		
Serial No:	Serial No:	
F. Principal Company Product or Business: Offshore Marine Terminal		
Principal Standard Industrial Classification Code (SIC): 4612		
Principal North American Industry Classification System (NAICS): 486910		
G. Projected Start of Construction Date: TBD		
Projected Start of Operation Date: TBD		

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I. Applicant Information (continued)		
H. Facility and Site Location Information (If no street address, provide clear driving directions to the site in writing.):		
Street Address: Site is approximately 14 miles offshore the coast of Texas, Southeast of Corpus Christi.		
City/Town: N/A	County: N/A	ZIP Code: N/A
Latitude (nearest second): 27° 28' 42.6"		Longitude (nearest second): 97° 00' 48.43"
I. Account Identification Number (leave blank if new site or facility):		
J. Core Data Form		
Is the Core Data Form (Form 10400) attached? If No, provide customer reference number and regulated entity number (complete K and L).		<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
K. Customer Reference Number (CN):		
L. Regulated Entity Number (RN):		
II. General Information		
A. Is confidential information submitted with this application? If Yes, mark each confidential page confidential in large red letters at the bottom of each page.		<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
B. Is this application in response to an investigation, notice of violation, or enforcement action? If Yes, attach a copy of any correspondence from the agency and provide the RN in section I.L. above.		<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
C. Number of New Jobs: N/A		
D. Provide the name of the State Senator and State Representative and district numbers for this facility site:		
State Senator: N/A		District No.: N/A
State Representative: N/A		District No.: N/A
III. Type of Permit Action Requested		
A. Mark the appropriate box indicating what type of action is requested.		
<input checked="" type="checkbox"/> Initial <input type="checkbox"/> Amendment <input type="checkbox"/> Revision (30 TAC § 116.116(e))		
<input type="checkbox"/> Change of Location <input type="checkbox"/> Relocation		
B. Permit Number (if existing):		
C. Permit Type: Mark the appropriate box indicating what type of permit is requested. (check all that apply, skip for change of location)		
<input checked="" type="checkbox"/> Construction <input type="checkbox"/> Flexible <input type="checkbox"/> Multiple Plant <input type="checkbox"/> Nonattainment <input type="checkbox"/> Plant-Wide Applicability Limit		
<input checked="" type="checkbox"/> Prevention of Significant Deterioration (PSD) <input type="checkbox"/> Hazardous Air Pollutant Major Source		
<input type="checkbox"/> PSD for greenhouse gases (GHGs) <input type="checkbox"/> Other: _____		

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III. Type of Permit Action Requested (continued)		
D. Is a permit renewal application being submitted in conjunction with this amendment in accordance with 30 TAC § 116.315(c).	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO	
E. Is this application for a change of location of previously permitted facilities?	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO	
If Yes, complete all parts of III.E.		
Current Location of Facility (If no street address, provide clear driving directions to the site in writing.):		
Street Address:		
City:	County:	ZIP Code:
Proposed Location of Facility (If no street address, provide clear driving directions to the site in writing.):		
Street Address:		
City:	County:	ZIP Code:
Will the proposed facility, site, and plot plan meet all current technical requirements of the permit special conditions? If "NO," attach detailed information.		<input type="checkbox"/> YES <input type="checkbox"/> NO
Is the site where the facility is moving considered a major source of criteria pollutants or HAPs?		<input type="checkbox"/> YES <input type="checkbox"/> NO
F. Consolidation into this Permit: List any standard permits, exemptions or permits by rule to be consolidated into this permit including those for planned maintenance, startup, and shutdown.		
List: N/A		
G. Are you permitting planned maintenance, startup, and shutdown emissions?		<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
If Yes, attach information on any changes to emissions under this application as specified in VII and VIII.		
H. Federal Operating Permit Requirements (30 TAC Chapter 122 Applicability)		
Is this facility located at a site required to obtain a federal operating permit?		<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> To be determined
If Yes, list all associated permit number(s), attach pages as needed).		
Associated Permit No (s.):		
Identify the requirements of 30 TAC Chapter 122 that will be triggered if this application is approved.		
<input type="checkbox"/> FOP Significant Revision	<input type="checkbox"/> FOP Minor	<input type="checkbox"/> Application for an FOP Revision
<input type="checkbox"/> Operational Flexibility/Off-Permit Notification	<input type="checkbox"/> Streamlined Revision for GOP	
<input checked="" type="checkbox"/> To be Determined	<input type="checkbox"/> None	

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III. Type of Permit Action Requested (continued)	
H. Federal Operating Permit Requirements (30 TAC Chapter 122 Applicability) (continued)	
Identify the type(s) of FOP(s) issued and/or FOP application(s) submitted/pending for the site. (check all that apply)	
<input type="checkbox"/> GOP Issued	<input type="checkbox"/> GOP application/revision application submitted or under APD review
<input type="checkbox"/> SOP Issued	<input type="checkbox"/> SOP application/revision application submitted or under APD review
IV. Public Notice Applicability	
A. Is this a new permit application or a change of location application?	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
B. Is this application for a concrete batch plant? If Yes, complete all parts of V.D.	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
C. Is this an application for a major modification of a PSD, nonattainment, FCAA § 112(g) permit, or exceedance of a PAL permit?	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
D. If this is an application for emissions of GHGs, select one of the following: <input type="checkbox"/> separate public notice (requires a separate application) <input checked="" type="checkbox"/> consolidated public notice	
E. Is this application for a PSD or major modification of a PSD located within 100 kilometers or less of an affected state or Class I Area?	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
If Yes, list the affected state(s) and/or Class I Area(s).	
List:	
F. Is this a state permit amendment application? If Yes, complete all parts of IV.F.	
Is there any change in character of emissions in this application?	<input type="checkbox"/> YES <input type="checkbox"/> NO
Is there a new air contaminant in this application?	<input type="checkbox"/> YES <input type="checkbox"/> NO
Do the facilities handle, load, unload, dry, manufacture, or process grain, seed, legumes, or vegetables fibers (agricultural facilities)?	<input type="checkbox"/> YES <input type="checkbox"/> NO
List the total annual emission increases associated with the application (List all that apply and attach additional sheets as needed):	
Volatile Organic Compounds (VOC):	
Sulfur Dioxide (SO ₂):	
Carbon Monoxide (CO):	
Nitrogen Oxides (NO _x):	
Particulate Matter (PM):	
PM 10 microns or less (PM ₁₀):	
PM 2.5 microns or less (PM _{2.5}):	
Lead (Pb):	
Hazardous Air Pollutants (HAPs):	
Other speciated air contaminants not listed above:	

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V. Public Notice Information (complete if applicable)			
A. Responsible Person: (<input type="checkbox"/> Mr. <input type="checkbox"/> Mrs. <input type="checkbox"/> Ms. <input type="checkbox"/> Other:) _____			
Name:			
Title:			
Company Name:			
Mailing Address:			
City:	State:	ZIP Code:	
Telephone No.:		Fax No.:	
E-mail Address:			
B. Technical Contact: (<input type="checkbox"/> Mr. <input type="checkbox"/> Mrs. <input type="checkbox"/> Ms. <input type="checkbox"/> Other:) ____			
Name:			
Title:			
Mailing Address:			
City:	State:	ZIP Code:	
Telephone No.:		Fax No.:	
E-mail Address:			
C. Name of the Public Place:			
Physical Address (No P.O. Boxes):			
City:	County:	ZIP Code:	
The public place has granted authorization to place the application for public viewing and copying.			<input type="checkbox"/> YES <input type="checkbox"/> NO
The public place has internet access available for the public.			<input type="checkbox"/> YES <input type="checkbox"/> NO
D. Concrete Batch Plants, PSD, and Nonattainment Permits			
County Judge Information (For Concrete Batch Plants and PSD and/or Nonattainment Permits) for this facility site.			
The Honorable:			
Mailing Address:			
City:	State:	ZIP Code:	

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V. Public Notice Information (complete if applicable)		
D. Concrete Batch Plants, PSD, and Nonattainment Permits (continued)		
Is the facility located in a municipality or an extraterritorial jurisdiction of a municipality? (For Concrete Batch Plants)		<input type="checkbox"/> YES <input type="checkbox"/> NO
Presiding Officers Name(s):		
Title:		
Mailing Address:		
City:	State:	ZIP Code:
Provide the name, mailing address of the chief executive for the location where the facility is or will be located.		
Chief Executive:		
Mailing Address:		
City:	State:	ZIP Code:
Provide the name, mailing address of the Indian Governing Body for the location where the facility is or will be located.		
Indian Governing Body:		
Mailing Address:		
City:	State:	ZIP Code:
Identify the Federal Land Manager(s) for the location where the facility is or will be located.		
Federal Land Manager(s):		
E. Bilingual Notice		
Is a bilingual program required by the Texas Education Code in the School District?		<input type="checkbox"/> YES <input type="checkbox"/> NO
Are the children who attend either the elementary school or the middle school closest to your facility eligible to be enrolled in a bilingual program provided by the district?		<input type="checkbox"/> YES <input type="checkbox"/> NO
If Yes, list which languages are required by the bilingual program?		
VI. Small Business Classification (Required)		
A. Does this company (including parent companies and subsidiary companies) have fewer than 100 employees or less than \$6 million in annual gross receipts?		<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
B. Is the site a major stationary source for federal air quality permitting?		<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
C. Are the site emissions of any regulated air pollutant greater than or equal to 50 tpy?		<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
D. Are the site emissions of all regulated air pollutants combined less than 75 tpy?		<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO

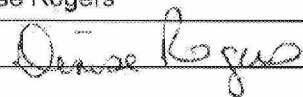
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VII. Technical Information	
A. The following information must be submitted with your Form PI-1 <i>(this is just a checklist to make sure you have included everything)</i>	
<input checked="" type="checkbox"/> Current Area Map <input checked="" type="checkbox"/> Plot Plan <input checked="" type="checkbox"/> Existing Authorizations <input checked="" type="checkbox"/> Process Flow Diagram <input checked="" type="checkbox"/> Process Description <input checked="" type="checkbox"/> Maximum Emissions Data and Calculations <input checked="" type="checkbox"/> Air Permit Application Tables <input checked="" type="checkbox"/> Table 1(a) (Form 10153) entitled, Emission Point Summary <input type="checkbox"/> Table 2 (Form 10155) entitled, Material Balance <input checked="" type="checkbox"/> Other equipment, process or control device tables	
B. Are any schools located within 3,000 feet of this facility?	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
C. Maximum Operating Schedule:	
Hour(s): 24	Day(s): 365
Week(s): 52	Year(s):
Seasonal Operation? If Yes, please describe in the space provide below.	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
Hour(s): Day(s): Week(s): Year(s):	
D. Have the planned MSS emissions been previously submitted as part of an emissions inventory?	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
Provide a list of each planned MSS facility or related activity and indicate which years the MSS activities have been included in the emissions inventories. Attach pages as needed.	
MSS Facility(s) or Activity	Year(s)
E. Does this application involve any air contaminants for which a disaster review is required?	
<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO	
If Yes, list which air contaminants require a disaster review.	

Texas Commission on Environmental Quality
Form PI-1 General Application for
Air Preconstruction Permit and Amendment
Page 8

VII. Technical Information (continued)	
F. Does this application include a pollutant of concern on the Air Pollutant Watch List (APWL)?	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
G. Are emissions of GHGs associated with this project subject to PSD?	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
If "yes," provide a list of all associated applications for this project:	
See attachments	
VIII. State Regulatory Requirements Applicants must demonstrate compliance with all applicable state regulations to obtain a permit or amendment. The application must contain detailed attachments addressing applicability or non-applicability; identify state regulations; show how requirements are met; and include compliance demonstrations.	
A. Will the emissions from the proposed facility protect public health and welfare, and comply with all rules and regulations of the TCEQ?	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
B. Will emissions of significant air contaminants from the facility be measured?	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
C. Is the Best Available Control Technology (BACT) demonstration attached?	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
D. Will the proposed facilities achieve the performance represented in the permit application as demonstrated through recordkeeping, monitoring, stack testing, or other applicable methods?	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
IX. Federal Regulatory Requirements Applicants must demonstrate compliance with all applicable federal regulations to obtain a permit or amendment. The application must contain detailed attachments addressing applicability or non-applicability; identify federal regulation subparts; show how requirements are met; and include compliance demonstrations.	
A. Does Title 40 Code of Federal Regulations Part 60, (40 CFR Part 60) New Source Performance Standard (NSPS) apply to a facility in this application?	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
B. Does 40 CFR Part 61, National Emissions Standard for Hazardous Air Pollutants (NESHAP) apply to a facility in this application?	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
C. Does 40 CFR Part 63, Maximum Achievable Control Technology (MACT) standard apply to a facility in this application?	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
D. Do nonattainment permitting requirements apply to this application?	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
E. Do prevention of significant deterioration permitting requirements apply to this application?	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
F. Do Hazardous Air Pollutant Major Source [FCAA § 112(g)] requirements apply to this application?	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
G. Is a Plant-wide Applicability Limit permit being requested?	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
X. Professional Engineer (P.E.) Seal	
Is the estimated capital cost of the project greater than \$2 million dollars?	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
If Yes, submit the application under the seal of a Texas licensed P.E.	

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XI. Permit Fee Information	
Check, Money Order, Transaction Number, ePay Voucher Number: N/A	
Fee Amount: \$ N/A	
Paid online? N/A	<input type="checkbox"/> YES <input type="checkbox"/> NO
Company name on check:	
Is a Table 30 (Form 10196) entitled, Estimated Capital Cost and Fee Verification, attached?	<input type="checkbox"/> YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> N/A
XII. Delinquent Fees and Penalties	
This form will not be processed until all delinquent fees and/or penalties owed to the TCEQ or the Office of the Attorney General on behalf of the TCEQ is paid in accordance with the Delinquent Fee and Penalty Protocol. For more information regarding Delinquent Fees and Penalties, go to the TCEQ Web site at: www.tceq.texas.gov/agency/fees/delin .	
XIII. Signature	
The signature below confirms that I have knowledge of the facts included in this application and that these facts are true and correct to the best of my knowledge and belief. I further state that to the best of my knowledge and belief, the project for which application is made will not in any way violate any provision of the Texas Water Code (TWC), Chapter 7; the Texas Health and Safety Code, Chapter 382, the Texas Clean Air Act (TCAA) the air quality rules of the Texas Commission on Environmental Quality; or any local governmental ordinance or resolution enacted pursuant to the TCAA. I further state that I understand my signature indicates that this application meets all applicable nonattainment, prevention of significant deterioration, or major source of hazardous air pollutant permitting requirements. The signature further signifies awareness that intentionally or knowingly making or causing to be made false material statements or representations in the application is a criminal offense subject to criminal penalties.	
Name: Denise Rogers	
Signature: 	<i>Original Signature Required</i>
Date: 10/26/2018	



TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date:	July 2018	Permit No.:	TBD	Regulated Entity No.:	
Area Name:	Texas Gulf Terminals Project			Customer Reference No.:	CN605490085

Review of applications and issuance of permits will be expedited by supplying all necessary information requested on this Table.

AIR CONTAMINANT DATA					
1. Emission Point			2. Component or Air Contaminant Name	3. Air Contaminant Emission Rate	
(A) EPN	(B) FIN	(C) NAME		(A) POUND	(B) TPY
LOADFUG	LOADFUG	Marine Loading	VOC	7774	10808
			H ₂ S	0.17	0.24

EPN = Emission Point Number

FIN = Facility Identification Number



TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date:	July 2018	Permit No.:	TBD	Regulated Entity No.:	
Area Name:	Texas Gulf Terminals Project			Customer Reference No.:	CN605490085

Review of applications and issuance of permits will be expedited by supplying all necessary information requested on this Table.

AIR CONTAMINANT DATA						EMISSION POINT DISCHARGE PARAMETERS							
1. Emission Point			4. UTM Coordinates of Emission Point			Source							
						5. Building	6. Height Above	7. Stack Exit Data			8. Fugitives		
EPN	FIN	Name	Zone	East	North	Height	Ground	Diameter	Velocity	Temperature	Length	Width	Axis
(A)	(B)	(C)		(Meters)	(Meters)	(Ft.)	(Ft.)	(Ft.) (A)	(FPS) (B)	(°F) (C)	(Ft.) (A)	(Ft.) (B)	Degrees (C)
LOADFUG	LOADFUG	Marine Loading	14	696278	3041006	120.0	0.0	4.7	50.0	455	360646	283707	0

EPN = Emission Point Number
FIN = Facility Identification Number

3. PROJECT LOCATION

The proposed DWP would be positioned within territorial seas of the OCS Mustang Island Area TX3 (Gulf of Mexico), within the Bureau of Ocean Energy Management (BOEM) block number 823. The proposed DWP is positioned at Latitude N27° 28' 42.60" and Longitude W97° 00' 48.43", approximately 12.7 nautical miles (14.62 statute miles) off the coast of North Padre Island in Kleberg County, Texas. Figure 3-1 provided below shows the location of the DWP terminal.

Figure 3-1. Location of the DWP Terminal



4. PROCESS AND PROJECT DESCRIPTION

4.1. CRITERIA POLLUTANTS EMISSIONS SUMMARY

The proposed SPM buoy system will enable Very Large Crude Carriers (VLCCs) to be fully and completely loaded directly with crude oil/condensate from the SPM. The crude oil/condensate will be supplied to the SPM buoy system from the Onshore Storage Terminal Facility (OSTF), through a pipeline infrastructure, and to the SPM buoy system. Two (2) 30-inch-diameter pipelines will each be capable of 30,000 bph flow rate allowing an overall system crude oil/condensate delivery capacity of 60,000 bph to vessels connected to the proposed SPM buoy system's loading hose. Vessels will be moored to the proposed SPM buoy system via mooring hawsers. Crude oil will be routed from subsea PLEM via two 24-inch ID flexible hoses to SPM buoy. Floating hoses will extend from the SPM buoy system to the moored vessel to allow for the loading of crude oil/condensate. The project will have a crude oil/condensate loading capacity of 60,000 bph and 192 million barrels per year. The project will be able to load up to approximately 96 large vessels per year.

4.2. PROJECT DESCRIPTION

The proposed project includes 14.62 miles of two (2) new paralleling 30-inch diameter offshore pipelines and the DWP.

Offshore pipelines - The proposed project requires the ability to export multiple grades of crude oil/condensate. As such, the proposed offshore pipeline infrastructure will comprise a dual pipeline system to allow for the flushing of lines of one crude grade back to the Onshore Storage Terminal Facility (OSTF). Under normal operations, the OSTF will pump crude oil/condensate through both offshore pipelines to the PLEM and SPM buoy system for the loading of vessels moored at the DWP.

DWP - The proposed SPM buoy system will consist of a Pipeline End Manifold (PLEM) system, mooring hawsers, and floating hoses to allow for the loading of crude oil to vessels connected to the proposed SPM buoy system's loading hose. The proposed SPM buoy system will be of the Catenary Anchor Leg Mooring (CALM) type permanently moored with a symmetrically arranged six-leg anchor chain system extending to pile anchors fixed on the seafloor. The proposed SPM buoy system will consist of inner and outer cylindrical shells subdivided into twelve equal-sized watertight radial compartments. A rotating table will be affixed to the SPM buoy and allow for the connection of moored vessels to the SPM buoy system via mooring hawsers. A series of floating hose strings equipped with marine break-away couplings will be utilized for the transfer of crude oil from the SPM buoy system to the moored vessel. Floating hoses will be equipped with strobe lights (Winkler Lights) at 15-foot intervals for detection at night and periods of low-light. The PLEM system that will serve as the connection point between subsea pipelines and the SPM buoy system through a series of 24-inch-diameter submarine hoses. The PLEM system would be a steel frame structure positioned directly beneath the proposed SPM buoy system and would be anchored directly to the seafloor with piles.

The only primary emissions involved in the proposed project are the VOC emissions resulting from the loading of crude oil/condensate from the SPM buoy system onto a VLCC.

4.3. ALTERNATIVES ANALYSIS

As mentioned in the project background, the purpose of the proposed SPM buoy system will be to fully and directly load VLCCs with crude oil/condensate for export. The proposed SPM buoy system is unique and different from current crude oil/condensate export operations that are currently conducted in the United States.

Because of their size (2 MMbbls fully loaded), VLCCs are used for long haul trips to transport cargos long distances across the globe economically. However, their immense size and draft limitations prevents VLCCs from navigating to onshore terminals to be loaded fully. Therefore, VLCCs are currently loaded by lightering, which is the process of using smaller ships to shuttle crude oil/condensate from onshore terminals out to the VLCC. As part of the lightering, crude oil/condensate is loaded onto the VLCC via ship-to-ship (STS) transfer in off-shore waters with a depth that VLCCs can navigate while fully loaded. Emissions from STS transfer during lightering operations are not regulated by CAA regulations and therefore result in uncontrolled emissions of VOC.

Lightering is the current practice for loading VLCCs with crude oil/condensate for export. The STS transfers that occur during the lightering operations generate similar emissions as will occur during when the proposed SPM buoy system conducts its marine tank vessel loading transfer process. However, lightering generates many other emissions during ship movements that do not occur with the SPM buoy system. When comparing wholistic emissions from the entire lightering process to the entire process associated with the use of the proposed SPM buoy system, the benefit of the proposed SPM buoy system is clear. Not only does the proposed SPM buoy system reduce the total amount of air emissions, but the proposed SPM buoy system also reduces ship channel traffic and results in a safer and more efficient process to fully load a VLCC with crude oil/condensate for export.

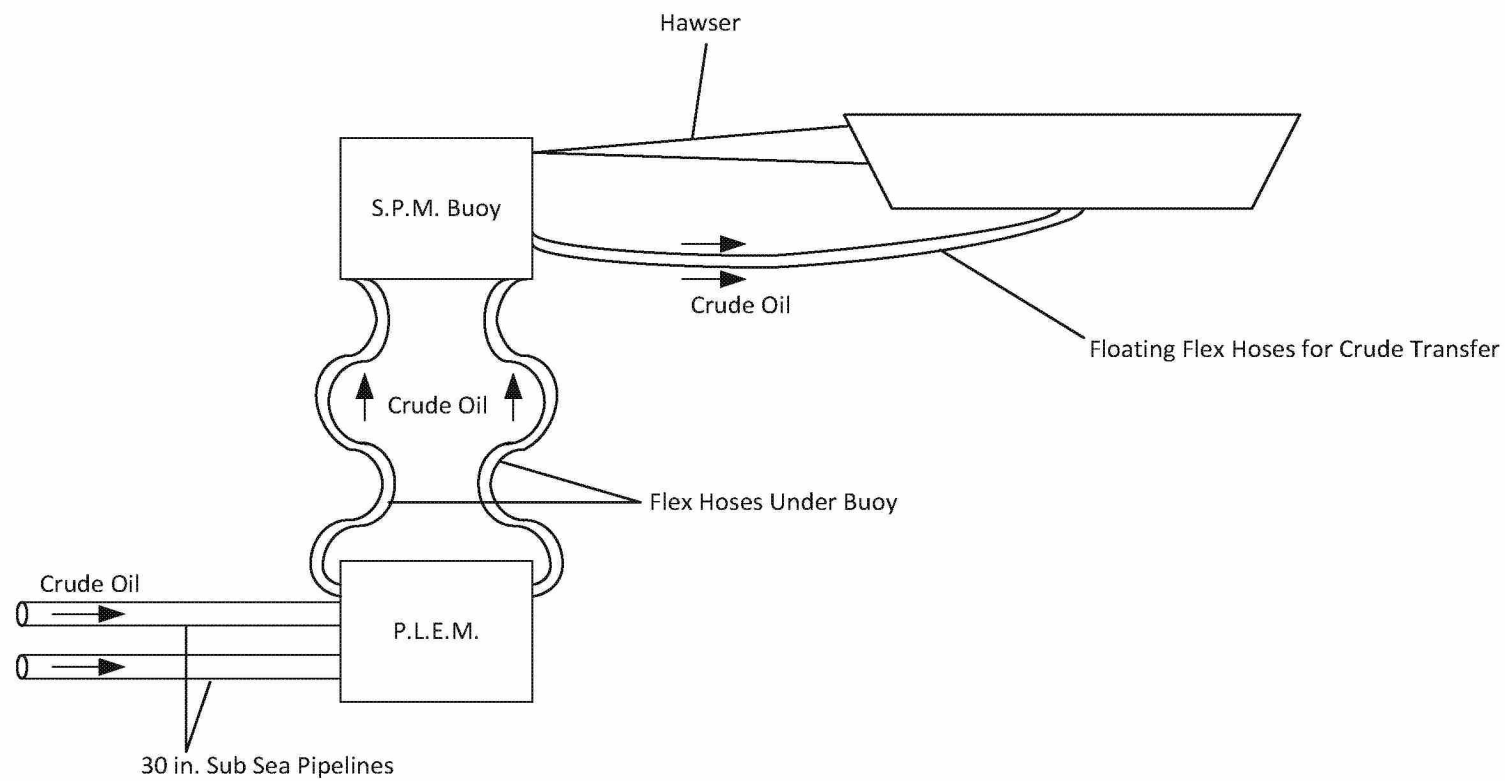
The additional air emissions impacts of lightering compared to the proposed SPM buoy system are generated from the additional combustion emissions required to shuttle the crude oil/condensate on smaller oil tankers from onshore terminals out to the VLCC. With the proposed SPM buoy system, the only tanker involved is the VLCC and it does not have to come any closer to shore than the location of the proposed SPM buoy system, saving on propulsion fuel use. Furthermore, any emissions from the VLCC will be produced further away from the public than those generated by lightering vessels. The table below shows a comparison of the wholistic potential emissions from lightering and the proposed SPM buoy system.

Emissions shown below include sources of air emissions that are NOT part of the DWP source, which is just the proposed SPM buoy system and its loading operations. Additional sources of emissions (which are not regulated under the scope of this application) such as auxiliary vessel emissions and support vessel emissions, are provided for informational purposes only for the alternatives analysis comparison. Detailed emission calculations for the alternatives emissions analysis are provided under separate cover in the *Air Quality Information for Environmental Impact Statement, Appendix A*.

Table 4-1 - Alternatives Emissions Analysis

Description of Activity	VOC tpy	NOx tpy	CO tpy	PM tpy	PM ₁₀ tpy	PM _{2.5} tpy	SO ₂ tpy	Total HAPs tpy	CO ₂ e tpy
Proposed Project Design									
Proposed Project Design - Total	10,855	1,673	343	69	55	52	88	201	134,484
Alternative Lightering Scenario Total ¹	13,246	3,136	579	127	111	104	124.9	248	251,871
<u>Emissions Reductions</u> (TPY) from Proposed SPM Design	2,424	1,463	236	58	56	52	37	47	117,387

1. Accounts for full and partial lightering of VLCC based on a representation of historical lightering operations. Emissions represent the emissions STS loading and any additional emissions generated in the lightering process (i.e., loading of lightering vessel onshore, propulsion of lightering vessel, etc.).



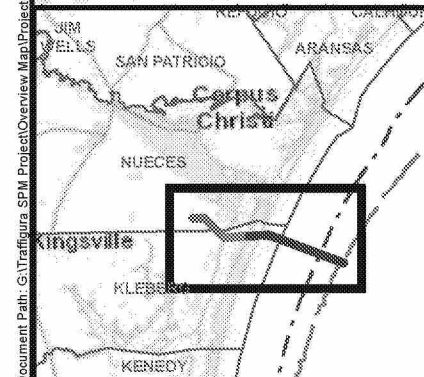
Texas Gulf Terminals Inc.

Process Flow Diagram

Trinity
Consultants

Project 184403.0005
April 2018

Document Path: G:\Traffic\SPM Project\Overview Map\ProjectComponentsMap.mxd



Legend

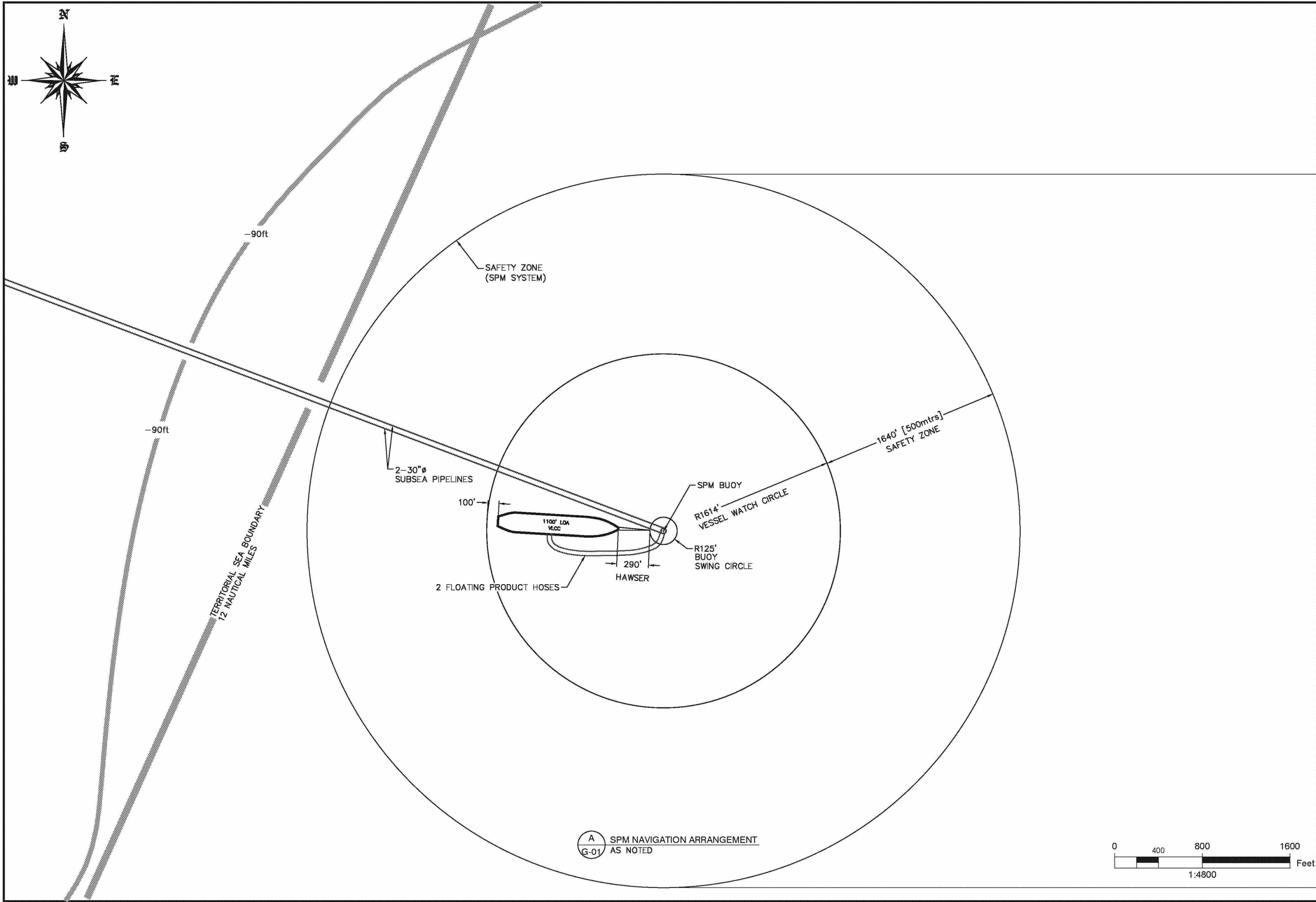
	Onshore Storage Facility Property		Inshore North Padre Island Segment		90ft Depth Contour
	Pump Station		Offshore Segment		Federal/State Line
	HDD Pipeline Section		SPM System and Safety Zone		GLO Lease Tracts
	Onshore Segment		Existing Pipelines (RRC)		Federal Lease Blocks
	Inshore Laguna Madre Segment		Parks, NWRs, WMAs		

Coordinate System: NAD 1983 StatePlane
Texas South Central FIPS 4204 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
Units: Foot US

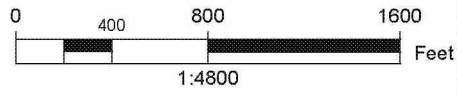
0 5,000 10,000 20,000 Feet

Project Component Overview Map
Texas Gulf Terminals Inc
Texas Gulf Terminals Project

Date: May 21, 2018	
Prepared By: CG	
Project: TGTI	
1 inch = 10,000 feet	



A SPM NAVIGATION ARRANGEMENT
G-01 AS NOTED



DESIGN BY: SL	
DRAWN BY: -	
DATE: MARCH 2018	SCALE: AS NOTED
SHEET: 2 OF 2	
DRAWING NO: 2	
REV. A	

ISSUED FOR REVIEW

NO. DESCRIPTION

MA/DO/YA DATE APPR

TEXAS GULF TERMINALS PROJECT

SPM ARRANGEMENT DETAIL

LOYD ENGINEERING, INC.
HOUSTON TEXAS, USA
LICENSE NO. F-002848

5. EMISSION CALCULATIONS

5.1. MARINE LOADING

Emissions from marine loading of crude oil/condensate are calculated based on TCEQ's Air Permit Technical Guidance for Chemical Sources: Loading Operations (October 2000) using the following equation from U.S. EPA's AP-42, Section 5.2:

$$L = 12.46 \times S \times P \times M/T$$

where:

- L = Loading Loss (lb/10³ gal of liquid loaded)
- S = Saturation factor
- P = True vapor pressure of liquid loaded (psia)
- M = Molecular weight of vapors (lb/lb-mole)
- T = Temperature of bulk liquid loaded (R)

A saturation factor of 0.2 is used for submerged loading using ships. A maximum true vapor pressure of 11 psia is used for crude oil/condensate loading.

6. FEDERAL NEW SOURCE REVIEW ANALYSIS

The proposed SPM buoy system will be located approximately 14 miles from the coast of Kleberg County. Due to unavailability of attainment/non-attainment information in project area offshore, TGTI proposes to use the attainment status of the nearest County onshore, which is Kleberg County. Kleberg County is considered in attainment or unclassified for all FNSR pollutants. Therefore, the project will not be subject to Non-attainment New Source Review (NNSR), and will only be subject to Prevention of Significant Deterioration (PSD) review if it is determined that emissions of criteria pollutants from the facility will trigger the major source threshold. A major stationary source is defined as either one of the sources identified in 40 CFR 51.166 and which has a PTE of 100 tons or more per year of any regulated pollutant, or any other stationary source which has a PTE of 250 tpy or more of a regulated pollutant. The proposed project is not on the list of 28 source categories listed in 40 CFR 51.166 which have a major source threshold of 100 tpy. Therefore, the proposed project will be subject to PSD if it is determined that emissions from the facility will exceed 250 tpy of any regulated pollutant.

The only FNSR pollutant from the proposed project will be VOC. Based on potential air emissions from the facility, the project will be subject to preconstruction review under the federal PSD regulations since potential VOC emissions will be greater than the 250 ton per year PSD major source threshold. Once one pollutant exceeds the PSD major source threshold, remaining pollutants are then compared to their significant emission rate (SER) to determine if the new major stationary source has the potential to emit the pollutants in significant amounts. PSD permitting is applicable to any other pollutants that exceed their respective SER.² As shown in Table 6-1, the only pollutant which is subject to PSD permitting is VOC.

Since VOC emissions are expected to be greater than 250 tpy, an ozone impacts analysis has to be performed. TGTI performed an ozone impacts analysis and it has been submitted under separate cover.

Table 6-1. FNSR PSD Analysis Summary

	NO _x (tpy)	CO (tpy)	VOC (tpy)	SO ₂ (tpy)	PM ₁₀ (tpy)	PM _{2.5} (tpy)	H ₂ S (tpy)	H ₂ SO ₄ (tpy)
<u>New Sources</u>								
Loading	--	--	10,808	--	--	--	0.24	--
Fugitives	--	--	0.22	--	--	--	--	--
<u>Total Project Increases:</u>	--	--	10,808	--	--	--	0.24	--
PSD Threshold	250	250	250	250	250	250	10	7
<u>PSD Review Required</u>	N/A	N/A	Yes	N/A	N/A	N/A	N/A	N/A

² 40 CFR 52.21(b)(23)

7. FEDERAL (TOP-DOWN) BACT

This section discusses the regulatory basis for BACT, approach used in completing the BACT analyses, and the BACT analyses for the proposed facility. Supporting documentation is included in Appendix C.

7.1. BACT DEFINITION

The requirement to conduct a BACT analysis is set forth in the PSD regulations [40 CFR 52.21(j)(2)]:

(j) Control Technology Review.

(2) A new major stationary source shall apply best available control technology for each regulated NSR pollutant that it would have the potential to emit in significant amounts.

BACT is defined in the PSD regulations [40 CFR 52.21(b)(12)] as:

...an emissions limitation (including a visible emission standard) based on the maximum degree of reduction for each pollutant subject to regulation under Act which would be emitted from any proposed major stationary source or major modification which the Administrator, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such source or modification through application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of such pollutant. In no event shall application of best available control technology result in emissions of any pollutant which would exceed the emissions allowed by any applicable standard under 40 CFR parts 60 and 61.
[primary BACT definition]

If the Administrator determines that technological or economic limitations on the application of measurement methodology to a particular emissions unit would make the imposition of an emissions standard infeasible, a design, equipment, work practice, operational standard, or combination thereof, may be prescribed instead to satisfy the requirement for the application of best available control technology. Such standard shall, to the degree possible, set forth the emissions reduction achievable by implementation of such design, equipment, work practice or operation, and shall provide for compliance by means which achieve equivalent results.
[allowance for secondary BACT standard under certain conditions]

The primary BACT definition can be best understood by breaking it apart into its separate components.

7.1.1. Case-By-Case Basis

a case-by-case basis, taking into account energy, environmental and economic impacts and other costs

Unlike many of the Clean Air Act programs, the PSD program's BACT evaluation is case-by-case. As noted by EPA,

The case-by-case analysis is far more complex than merely pointing to a lower emissions limit or higher control efficiency elsewhere in a permit or a permit application. The BACT determination must take into account all of the factors affecting the facility The BACT analysis, therefore, involves judgment and balancing.

To assist applicants and regulators with the case-by-case process, in 1987 EPA issued a memorandum that implemented certain program initiatives to improve the effectiveness of the PSD program within the confines of existing regulations and state implementation plans. Among the initiatives was a “top-down” approach for determining BACT. In brief, the top-down process suggests that all available control technologies be ranked in descending order of control effectiveness. The most stringent or “top” control option is the default BACT emission limit unless the applicant demonstrates, and the permitting authority in its informed opinion agrees, that energy, environmental, and/or economic impacts justify the conclusion that the most stringent control option is not achievable in that case. Upon elimination of the most stringent control option based upon energy, environmental, and/or economic considerations, the next most stringent alternative is evaluated in the same manner. This process continues until BACT is selected.

The five steps in a top-down BACT evaluation can be summarized as follows:

- Step 1. Identify all possible control technologies
- Step 2. Eliminate technically infeasible options
- Step 3. Rank the technically feasible control technologies based upon emission reduction potential
- Step 4. Evaluate ranked controls based on energy, environmental, and/or economic considerations
- Step 5. Select BACT

While the top-down BACT analysis is a procedural approach suggested by the EPA policy, this approach is not specifically mandated as a statutory requirement of the BACT determination. It should be noted that the BACT limit is an emissions limitation or work practice standard and ultimately, does not require the installation of any specific control devices.

7.1.2. Achievable

based on the maximum degree of reduction ...[that DEP] ... determines is achievable ... through application of production processes or available methods, systems and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques

BACT is to be set at the lowest value that is achievable. However, there is an important distinction between emission rates achieved at a specific time on a specific unit, and an emission limitation that a unit must be able to meet continuously over its operating life. As discussed by the D.C. Circuit Court of Appeals

*In National Lime Ass'n v. EPA, 627 F.2d 416, 431 n.46 (D.C. Cir. 1980), we said that where a statute requires that a standard be "achievable," it must be achievable "under most adverse circumstances which can reasonably be expected to recur."*³

EPA has reached a similar conclusion in prior determinations for PSD permits.

*Agency guidance and our prior decisions recognize a distinction between, on the one hand, measured 'emissions rates,' which are necessarily data obtained from a particular facility at a specific time, and on the other hand, the 'emissions limitation' determined to be BACT and set forth in the permit, which the facility is required to continuously meet throughout the facility's life. Stated simply, if there is uncontrollable fluctuation or variability in the measured emission rate, then the lowest measured emission rate will necessarily be more stringent than the "emissions limitation" that is "achievable" for that pollution control method over the life of the facility. Accordingly, because the "emissions limitation" is applicable for the facility's life, it is wholly appropriate for the permit issuer to consider, as part of the BACT analysis, the extent to which the available data demonstrate whether the emissions rate at issue has been achieved by other facilities over a long term.*⁴

Thus, BACT must be set at the lowest feasible emission rate recognizing that the facility must be in compliance with that limit for the lifetime of the facility on a continuous basis. While viewing individual unit performance can be instructive in evaluating what BACT might be, any actual performance data must be viewed carefully, as rarely will the data be adequate to truly assess the performance that a unit will achieve during its entire operating life. While statistical variability of actual performance can be used to infer what is "achievable," such testing requires a detailed test plan akin to what teams in EPA use to develop MACT standards over a several year period, and is far behind what is reasonable to expect of an individual source. In contrast to limited snapshots of actual performance data, emission limits from similar sources can reasonably be used to infer what is "achievable."⁵

To assist in meeting the BACT limit, the source must consider production processes or available methods, systems or techniques, as long as those considerations do not redefine the source.

³ As quoted in *Sierra Club v. EPA* (97-1686).

⁴ EPA Environmental Appeals Board decision, *In re: Newmont Nevada Energy Investment L.L.C.* PSD Appeal No. 05-04, decided December 21, 2005. Environmental Administrative Decisions Volume 12, Page 442.

⁵ Emission limits must be used with care in assessing what is "achievable." Limits established for facilities which were never built must be viewed with care, as they have never been demonstrated and that company never took a significant liability in having to meet that limit. Likewise, permitted units which have not yet commenced construction must also be viewed with care for similar reasons.

7.1.3. Floor

Emissions [shall not] exceed ...[40 CFR Parts 60, 61, 63]

The least stringent emission rate allowable for BACT is any applicable limit under Part 60 (NSPS) or Part 61 (NESHAP). State SIP limitations must also be considered when determining the floor, such as those in Chapter 62 of the F.A.C. Although the definition of BACT in 40 CFR 52.21(b)(12) does not explicitly include NESHAPs in 40 CFR Part 63, limits for PSD pollutants set by this rule are often considered as well.

7.2. BACT REQUIREMENT

The BACT requirement applies to each new and modified emission unit for which there are emissions increases of pollutants subject to PSD review. The proposed SPM buoy system is subject to PSD review for VOC only.

7.3. BACT ASSESSMENT METHODOLOGY

The following sections provide detail on the BACT assessment methodology utilized in preparing the BACT analysis for the proposed SPM buoy system. As previously noted, the minimum emission limit to be considered in a BACT assessment must result in an emission rate less than or equal to any applicable NSPS or NESHAP emission rate for the source. Since, there are no applicable NSPS or NESHAP emission rates for the proposed SPM buoy system, there is no applicable BACT floor.⁶

7.3.1. Identification of Potential Control Technologies

Potentially applicable emission control technologies were identified by researching the EPA control technology database, technical literature, control equipment vendor information, state permitting authority files, and by using process knowledge and engineering experience. The Reasonably Available Control Technology (RACT)/BACT/Lowest Achievable Emission Rate (LAER) Clearinghouse (RBLC), a database made available to the public through the EPA's Office of Air Quality Planning and Standards (OAQPS) Technology Transfer Network (TTN), lists technologies and corresponding emission limits that have been approved by regulatory agencies in permit actions. These technologies are grouped into categories by industry and can be referenced in determining what emissions levels were proposed for similar types of emissions units.

TGTI performed searches of the RBLC database to start identifying the emission control technologies and emission levels that were determined by permitting authorities as BACT within the past ten years for emission sources comparable to the proposed sources. The following emission source categories were searched:

- Petroleum Liquid Marketing (RBLC Code 42.004)
- Volatile Organic Liquid Marketing (RBLC Code 42.010)

⁶ See Regulatory Applicability portion of application narrative.

- Other Liquid Marketing Sources (RBLC Code 42.999)

TGTI also searched the following phrases in the RBLC database:

- | | |
|----------------------------|------------------------|
| ➤ SPM | ➤ Single Point Mooring |
| ➤ Mooring | ➤ Mooring System |
| ➤ Off-shore | ➤ Off-shore Loading |
| ➤ Off-shore Marine Loading | ➤ Off-shore Terminal |
| ➤ Marine Terminal | ➤ Marine Loading |
| ➤ Vessel Loading | ➤ Marine Vessel |
| ➤ Marine Off-loading | ➤ Loading Buoy |
| ➤ Marine Tanker | ➤ Tanker Loading |
| ➤ Tanker Ships | ➤ Deepwater |
| ➤ Deepwater Port | ➤ Deepwater Loading |
| ➤ Deepwater Marine Loading | ➤ Deepwater Terminal |
| ➤ Subsea Loading | ➤ Export Tanker |
| ➤ Production Platform | |

7.3.2. Technical Feasibility Analysis

The technical feasibility of control options identified was evaluated based on the New Source Review Workshop Manual, 1990 (the Manual). The Manual identifies two key concepts in determining if an undemonstrated technology is feasible: “availability” and “applicability.” A technology is “available” if it can be obtained by the applicant through commercial channels or is otherwise available within the common sense meaning of the term. Further, an available technology is “applicable” if it can reasonably be installed and operated on the source type under consideration. Only if a technology is both available and applicable is it considered technically feasible.

The Manual leaves the decisions about technical feasibility up to the review authority and states that in the absence of an explanation of why a control option is technically infeasible, it can be presumed the control option is technically feasible. The applicant is responsible for providing a factual demonstration of infeasibility based on commercial unavailability and/or unusual circumstances which make the control option technically infeasible. Such a demonstration can involve an evaluation of the pollutant-bearing gas stream characteristics or unresolvable technical difficulty applying the control such as the size of the unit, location of the proposed site, and operating problems related to specific circumstances of the source. With respect to control devices still under research and development, the Manual states the following:

A source would not be required to experience extended time delays or resource penalties to allow research to be conducted on a new technique. Neither is it expected that an applicant would be required to experience extended trials to learn how to apply a technology on a totally new and dissimilar source type. Consequently, technologies in the pilot scale testing stages of development would not be considered available for BACT review.

TGTI has completed a technical evaluation of each of the identified control devices as it pertains to the proposed SPM buoy system.

7.4. DEFINING THE SOURCE

Historical practices, as well as recent court rulings, have been clear that a key foundation of the BACT process is that BACT is applied to the type of source proposed by the applicant, and that redefining the source is not appropriate in a BACT determination.

Though BACT is based on the type of source as proposed by the applicant, the scope of the applicant's ability to define the source is not absolute. As EPA notes, a key task for the reviewing agency is to determine which parts of the proposed process are inherent to the applicant's purpose and which parts may be changed without changing that purpose. As discussed by EPA in an opinion on the Prairie State project,

We find it significant that all parties here, including Petitioners, agree that Congress intended the permit applicant to have the prerogative to define certain aspects of the proposed facility that may not be redesigned through application of BACT and that other aspects must remain open to redesign through application of BACT.⁷

...

When the Administrator first developed [EPA's policy against redefining the source] in Pennsauken, the Administrator concluded that permit conditions defining the emissions control systems "are imposed on the source as the applicant has defined it" and that "the source itself is not a condition of the permit."⁸

Given that some parts of the project are not open for review under BACT, EPA then discusses that it is the permit reviewer's burden to define the boundary. Based on precedent set in multiple prior EPA rulings (e.g., Pennsauken County Resource Recovery [1988], Old Dominion Electric Coop [1992], Spokane Regional Waste to Energy [1989]), EPA states the following in Prairie State.

For these reasons, we conclude that the permit issuer appropriately looks to how the applicant, in proposing the facility, defines the goals, objectives, purpose, or basic design for the proposed facility. Thus, the permit issuer must be mindful that BACT, in most cases, should not be applied to regulate the applicant's objective or purpose for the proposed facility, and therefore, the permit

⁷ EPA Environmental Appeals Board decision, *In re: Prairie State Generating Company*. PSD Appeal No. 05-05, decided August 24, 2006, Page 26.

⁸ EPA Environmental Appeals Board decision, *In re: Prairie State Generating Company*. PSD Appeal No. 05-05, decided August 24, 2006, Page 29.

issuer must discern which design elements are inherent to that purpose, articulated for reasons independent of air quality permitting, and which design elements may be changed to achieve pollutant emissions reductions without disrupting the applicant's basic business purpose for the proposed facility⁹

EPA's opinion in *Prairie State* was upheld on appeal to the Seventh Circuit Court of Appeals, where the court affirmed the substantial deference due the permitting authority on defining the demarcation point.¹⁰ Taken as a whole, the permitting agency is tasked with determining which controls are appropriate, but the discretion of the agency does not extend to a point requiring the applicant to redefine the source.

7.4.1. Proposed Source

TGTI is proposing to build a new a SPM buoy system for off-shore marine loading of crude/condensate located approximately 14 miles off-shore of the outer bank of Mustang Island. It is essential to the scope of the project that the proposed facility is an off-shore facility. Being located approximately 14 miles off-shore enables the SPM buoy system to fully and directly load VLCCs, which are not possible at any existing on-shore facilities because of water depth limitations. The proposed SPM buoy system is a single buoy for which a vessel can moor itself to for loading of crude oil/condensate. TGTI considers mooring system designs other than an SPM buoy system to be outside the scope of the proposed source since other mooring systems would require a complete redesign and reevaluation of the project.

The SPM buoy system itself will contain no engines, pumps, or loading equipment other than the necessary hoses to connect the vessel to subsea pipeline. All pumps and storage tanks will be located onshore at a separate facility. Emissions from auxiliary sources (miscellaneous tanks on the tanker vessel, combustion emissions from vessel engines, combustion emissions from tug boat engines, etc) are not included in this BACT analysis because they are not part of the scope for the proposed source and are considered secondary emissions.

7.5. SHIP LOADING - VOC BACT

7.5.1. Background on Pollutant Formation

The loading of organic liquids such as crude oil/condensate into marine vessels generates emissions of VOC organic vapors are displaced in the process. The composition of the displaced vapors are a mix of vapors formed in the empty ship from residual product from previous loads and vapors generated in the

⁹ EPA Environmental Appeals Board decision, *In re: Prairie State Generating Company*. PSD Appeal No. 05-05, decided August 24, 2006, Page 30. See also EPA Environmental Appeals Board decision, *In re: Desert Rock Energy Company LLC*. PSD Appeal Nos. 08-03, 08-04, 08-05 & 08-06, decided Sept. 24, 2009, page 64 ("The Board articulated the proper test to be used to [assess whether a technology redefines the source] in *Prairie State*.").

¹⁰ *Sierra Club v. EPA and Prairie State Generating Company LLC*, Seventh Circuit Court of Appeals, No. 06-3907, August 24, 2007. Rehearing denied October 11, 2007.

ship as the product is loaded. Therefore the following parameters effect the evaporative losses generated from loading operations:

- Physical and chemical characteristics of the previous cargo,
- Method of unloading the previous cargo,
- Operations to transport the empty carrier to a loading terminal,
- Method of loading the new cargo, and
- Physical and chemical characteristics of the new cargo.

For the proposed SPM buoy system, the method of loading new cargo is the only variable within TGTI's control that can influence the emissions from the loading operations. In splash loading, the fill pipe is partly loaded into the top of the tank and the cargo is allowed to splash onto the liquid surface in the tank. This creates high degrees of turbulence on the surface and increased surface area of liquid to vapor contact during the loading. The increased surface area leads to an increased partial pressure (higher saturation) from product vapors (VOC). Submerged loading allows the tank to be loaded without impacting the surface of the liquid. Submerged loading can be accomplished by either submerged pipe fill or bottom loading. Both methods of submerged loading load the cargo such that the fill pipe opening is below the liquid surface level and therefore does not disturb the liquid surface. As a result, the surface area of liquid product exposed to air is considerably lower than compared to splash loading.

7.5.2. Identification of Potential Control Technologies

Using the RBLC search, permit reviews, and a review of technical literature, potentially applicable VOC control technologies for marine loading operations were identified based on principles of control technology and engineering experience for marine loading.

Potential VOC mitigation options identified were:

- Submerged Loading

Potential VOC reduction options identified were:

- Vapor Recovery Unit (VRU)
- Vapor Combustion Unit (VCU)

These control technologies are briefly discussed in the following sections.

7.5.2.1. Submerged Loading

Submerged loading in the case of the proposed SPM buoy system is a loading procedure by which the discharge of crude oil/condensate into the VLCC tanks is located at or below the surface of the crude oil/condensate in the vessel. By discharging the crude oil/condensate into the hold at a point below the surface of the liquid, VOC emissions are mitigated compared to splash loading because the surface of the cargo is not disturbed in submerged loading. Compared to splash loading, this minimizes the generation

of VOC emissions because it reduces the surface area liquid/vapor interface and thus minimizes the volatilization of hydrocarbons from the liquid.

7.5.2.2. VOC Management Plan

Regulation 15.6 of the International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI requires that all tankers carrying crude oil have an approved and effectively implemented ship specific VOC Management Plan covering at least the points given in the regulation. Guidelines for the development of VOC Management Plans is given in Marine Environmental Protection Committee Resolution 185(59) (MEPC.185(59)) and additional information on systems and operations of VOC Management Plans is given in MEPC.1/Circ.680. For reference, MEPC.185(59) and MEPC.1/Circ.680 have been provided as Appendices C and D, respectively.

The VOC Management Plan is a ship-specific management plan designed to ensure that the operation of a tanker, to which Regulation 15 of MARPOL Annex VI applies, prevents or minimizes VOC emissions to the extent possible. To comply with the plan, the loading and carriage of cargoes which generate VOC emissions should be evaluated and procedures written to ensure that the operations of a ship follow best management practices for preventing and minimizing VOC emissions to the extent possible. With respect to the loading operations at the proposed SPM buoy system, Rule 1.4. of the VOC Management Plan Guideline (MEPC.185(59)) states that while maintaining the safety of the ship, the VOC Management Plan should encourage and set forth the following best management practices as appropriate:

1. The loading procedures should take into account potential gas releases due to low pressure and, where possible, the routing of oil from crude oil manifolds into the tanks should be done so as to avoid or minimize excessive throttling and high flow velocity in pipes;
2. The ship should define a target operating pressure for the cargo tanks. This pressure should be as high as safely possible and the ship should aim to maintain tanks at this level during the loading and carriage of relevant cargo;
3. When venting to reduce tank pressure is required, the decrease in the pressure in the tanks should be as small as possible to maintain the tank pressure as high as possible;
4. The amount of inert gas added should be minimized. Increasing tank pressure by adding inert gas does not prevent VOC release but it may increase venting and therefore increase VOC emissions.

Technical information for the development of VOC Management Plans for tankers carrying crude oil are provided in MEPC.1/Circ.680 (Appendix D).

7.5.2.3. Vapor Recovery Unit

A VRU captures vapors emitted during loading operations then routes them to VRU equipment to be absorbed and reintroduced into the process. The captured vapors are converted back into a liquid by using refrigeration, absorption, adsorption, and/or compression. Given the location of the proposed SPM buoy system, there is not a suitable location for the VRU equipment. A VRU would require a separate platform or the means for captured vapors to be routed back to an onshore VRU.

7.5.2.4. Vapor Combustion Unit

A VCU captures vapors emitted during loading operations and routes them to a combustion device for control. While this control method reduces the emissions of VOC, it creates collateral emissions increases of pollutants from combustion. Given the location of the proposed SPM buoy system, there is not a suitable location for the VCU equipment. A VCU would require a separate platform or the means for captured vapors to be routed back to an onshore VCU.

7.5.3. Elimination of Technically Infeasible Control Options

After the identification of potential control options, the second step in the BACT assessment is to eliminate technically infeasible options. A control option is eliminated from consideration if there are process-specific conditions that would prohibit the implementation of the control or if the highest control efficiency of the option would result in an emission level that is higher than any applicable regulatory limits.

Based on this analysis of technical feasibility, VRU and VCU are both technically infeasible for application to the proposed SPM buoy system. Reasons for eliminating each option are identified below.

7.5.3.1. Vapor Combustion Unit

TGTI identified a VCU as a potential control technology because of its demonstrated ability to control emissions from land-based terminals. Though VCUs are demonstrated for land-based terminals, they have not been demonstrated as a control technology on sources similar to the proposed SPM buoy system. Application of VCU technology to the proposed SPM buoy system faces several inherent design challenges when compared to their application at land-based facilities, as identified below.

- Space Limitations
 - ✦ The proposed SPM buoy system is a single buoy floating roughly 14 miles offshore. The proposed SPM buoy system is not physically capable of housing equipment necessary for operation of a VCU. Modifications to the SPM buoy system to accommodate a VCU at the source is not a technically feasible option. Such modification would require the design and construction of a novel platform and vapor collection system that has not been demonstrated before. Such a platform would have to be located outside of the designated “swing circle” around the SPM buoy. The swing circle is the area around the SPM buoy in which the ship being loading is allowed to weathervane, or swing, around the SPM buoy during loading. This process is essential to the safety and design of the SPM buoy system as it allows the ship to optimally position itself around the SPM buoy to minimize the forces on the SPM buoy system. To allow for this movement pattern, a platform housing a VCU would have to be located safely outside of this circle, which is typically on the order of 1,500 to 2,000 ft in all directions. The vapor collection system would consist of a vapor collection line back to the SPM buoy, down to a subsea pipeline, then out to the VCU platform via this subsea pipeline. A vapor collection system of this manner has not been demonstrated in practice.

- Safety and Reliability Considerations Due to Variability in Operating Conditions
 - As described above, the vapor collection system that would be required for a VCU at the SPM buoy would be a new and unique system that is not currently in place at an SPM buoy system. The distance that the vapor collection line will have to travel underwater presents a reliability concern for the system. The long distance traversed by the vapor collection lines underwater increases the chances of condensed vapors in the vapor collection lines which would create both operational reliability and safety concerns. The other main concern is the constantly variable ocean conditions. Since the VCU equipment would have to be located on a floating platform, the natural motion of ocean waves will disturb the operation of the VCU and lead to unavoidable safety and reliability concerns.

Given the technical issues cited above VCU control technology is not an “applicable” technology to the proposed SPM buoy system since it cannot reasonably be installed and operated on the source type under consideration. Therefore VCU technology is eliminated from consideration as a technically infeasible control option.

7.5.3.2. Vapor Recovery Unit

TGTI identified a VRU as a potential control technology because of its demonstrated ability to control emissions from land-based terminals. Though VRUs are demonstrated for land-based terminals, they have not been demonstrated as a control technology on sources similar to the SPM buoy system. Application of VRU technology to the proposed SPM buoy system faces several design challenges when compared to their application at land-based facilities, as identified below.

- Space Limitations
 - The proposed SPM buoy system is a single buoy floating roughly 14 miles offshore. The proposed SPM buoy system is not physically capable of housing equipment necessary for operation of a VRU. Modifications to the SPM buoy system to accommodate a VRU at the source is not a technically feasible option. Such modification would require the design and construction of a novel platform and vapor collection system that has not been demonstrated before. Such a platform would have to be located outside of the designated “swing circle” around the SPM buoy. The swing circle is the area around the SPM buoy in which the ship being loading is allowed to weathervane, or swing, around the SPM buoy during loading. This process is essential to the safety and design of the SPM buoy system as it allows the ship to optimally position itself around the SPM buoy to minimize the forces on the SPM buoy system. To allow for this movement pattern, a platform housing a VRU would have to be located safely outside of this circle, which is typically on the order of 1,500 to 2,000 ft in all directions. The vapor collection system would consist of a vapor collection line back to the SPM buoy, down to a subsea pipeline, then out to the VRU platform via this subsea pipeline. A vapor collection system of this manner has not been demonstrated in practice.
- Safety and Reliability Considerations Due to Variability in Operating Conditions

- ✱ As described above, the vapor collection system that would be required for a VRU at the SPM buoy would be a new and unique system that is not currently in place at an SPM buoy system. The distance that the vapor collection line will have to travel underwater presents a reliability concern for the system. The long distance traversed by the vapor collection lines underwater increases the chances of condensed vapors in the vapor collection lines which would create both operational reliability and safety concerns. The other main concern is the constantly variable ocean conditions. Since the VRU equipment would have to be located on a floating platform, the natural motion of ocean waves will disturb the operation of the VRU and lead to unavoidable safety and reliability concerns. Traditional VRU control technology uses a tall absorber tower that, because of the height, will experience large oscillations at the tip, even from relatively small movement at the base from waves.

Given the technical issues cited above, VRU control technology is not an “applicable” technology to the proposed SPM buoy system since it cannot be reasonably be installed and operated on the source type under consideration. Therefore, traditional VRU technology is eliminated from consideration as a technically infeasible control option.

TGTI is aware of a technical report published on a spray absorption system that could theoretically be located on a floating platform and operate in spite of the influence of natural wave motions.¹¹ In this technical report, the concept of building a spray absorption VRU on a barge is theorized and a small-scale test was completed to demonstrate collection efficiency of the proposed design. The test described in the technical paper was completed at a flow rate of ~100x less than would be required for the proposed SPM buoy system. Additionally, the test was completed on fixed land, not a floating barge. Because of these reasons, the spray absorption VRU system on a barge is not considered technically available. Per the Manual there are several stages of bringing a control technology concept to reality as a commercial product that are as follows:

- Concept stage;
- Research and patenting;
- Bench scale or laboratory testing;
- Pilot scale testing;
- Licensing and commercial demonstration; and commercial sales.

The Manual states that a control technology is considered available if it has reached the licensing and commercial stages of development. The spray absorption VRU control system has only reached the bench scale or laboratory testing stage of development since it has only been demonstrated on a very small scale and on fixed land. The spray absorption VRU control technology is not technically available for application to the proposed SPM buoy system and is therefore not technically feasible.

¹¹ Yoshiki, Shibuya. “Vapor Recovery Technique for Crude Oil Ship Loading – Spray Absorption.” JFE Technical Report No. 19. March 2014, p. 158-166.

7.5.4. Rank of Remaining Control Technologies

The third of the five steps in the top-down BACT assessment procedure is to rank technically feasible control technologies by control effectiveness. The remaining control technologies, ranked by effectiveness, are presented in the following table.

Table 7-1 – Rank of Remaining Control Technologies (VOC)

Rank	Control Technology	Expected Removal Efficiency
1	Submerged Loading	60% ¹²
2	Work Practice Standards ¹³	N/A

7.5.5. Evaluation of Most Stringent Control

The fourth of the five steps in the top-down BACT assessment procedure is to evaluate the most effective control and document the results. Since submerged loading and only loading ships which have onboard and implement a VOC management plan that complies with the requirements of MEPC.185(59) are both being proposed as BACT, no further analysis is required.

7.5.6. Selection of BACT

Based on the previous analyses, TGTI has determined that submerged loading onto vessels which have onboard and implement a VOC management plan that complies with the requirements of MEPC.185(59) is BACT for the proposed SPM buoy system.

Table 7-2 – Summary of Proposed BACT (VOC)

Emission Unit	Pollutant	BACT Determination	Proposed BACT Emission Limit	Averaging Period
SPM Buoy System	VOC	Submerged Loading and loading ships which comply with VOC management plan requirements in MEPC.185(59)	N/A	N/A

¹² Reduction in emissions generated from loading compared to splash loading (75 FR 65115, Oct. 21, 2010).

¹³ Work practice standards include a variety of VOC management principles that would be included in a VOC management plan required in MEPC.185(59).

8. AIR QUALITY MODELING AND OTHER IMPACT ANALYSES

While the NAAQS compliance demonstration and State Health Effects Review are being submitted under separate cover, the Additional Impacts Analysis is addressed below.

8.1. ADDITIONAL IMPACTS ANALYSIS

Due to the large distance of the Project's location from land areas, TGTI believes that the following impact analyses would not be applicable to the proposed project:

- Growth analysis
- Soils and vegetation analysis
- Visibility impairment analysis

Federal and TCEQ guidelines require that an air quality dispersion modeling analysis (including visibility analysis) be performed for each Class I area located within 100 km of a facility undergoing an installation/modification that exceeds PSD significant emission rates. Since the nearest Class I area is more than 500 km from the proposed SPM buoy system, a Class I area analysis is not required.

9. GENERAL APPLICATION REQUIREMENTS

This section discusses the state and federal air regulatory applicability for the SPM buoy system. The Deepwater Port Act of 1974 (DWPA) provides EPA authority to apply the CAA to activities associated with deepwater ports.¹⁴ Per Section 1502(9)(D) of the DWPA a deepwater port is considered a new source for the purposes of the CAA(codified at 42 U.S.C. 7401 et seq.). Therefore, before a deepwater port may be constructed, the owner or operator must receive a new source review (NSR) permit from the EPA.

Additionally, 33 U.S.C. § 1518 (b) states that the law of the nearest adjacent coastal state is declared to be the law of the United States, and shall apply to any deepwater port licensed under the chapter. The nearest adjacent coastal state shall be the state whose seaward boundaries, if extended beyond 3 miles, would encompass the site of the deepwater port. Therefore, the laws of Texas are applicable to the proposed SPM buoy system. As such, in addition to an evaluation of the federal air regulatory applicability, this section also contains an evaluation of the Texas state air regulatory applicability.

In accordance with the DWPA and the provisions of Title I and Title V of the CAA, EPA will issue a new source review preconstruction permit. Though the federal operating permit program under 40 CFR 71 does not require a Title V application until 12 months after commencing operation, TGTI will prepare a Title V application to be submitted prior to operation of the proposed SPM buoy system. Since Texas is the “nearest adjacent coastal state, the Texas’ EPA-approved SIP will be used to determine major NSR and Title V applicability. EPA however, will be the primary permitting authority.

CAA provision that are potentially applicable to the proposed SPM buoy system include the following:

- National Ambient Air Quality (NAAQS) regulations;
- Prevention of Significant Deterioration (PSD) regulations;
- New Source Performance Standards (NSPS);
- National Emission Standards for Hazardous Air Pollutants (NESHAP);
- Title V Operating Report;
- Compliance Assurance Monitoring (CAM);
- Risk Management Program (RMP); and
- Texas Commission on Environmental Quality (TCEQ) Regulations;

9.1. FEDERAL REGULATORY REQUIREMENTS

The proposed SPM buoy system will be located about 14 miles off the coast of Kleberg County, TX. Since the proposed location is located off the coast, it is not designated as attainment or nonattainment with respect to the EPA’s NAAQS standards. While designation of the attainment status of the proposed location will be made on a case-by-case basis, it can be reasonably assumed given the closest designated areas are in attainment or unclassifiable for all pollutants, that the proposed location will be considered by EPA to be in attainment or unclassifiable as well. As such, the regulatory applicability analysis presented assumes the proposed location to be in attainment or unclassifiable with respect to the NAAQS standards.

¹⁴ 33 CFR 148.3

9.1.1. Prevention of Significant Deterioration Regulations

A stationary source is considered “major” for PSD if it is located in an attainment/unclassifiable area and has the potential to emit either (1) 100 tpy or more of a regulated pollutant if the source is classified as one of the 28 designated industrial source categories, or (2) 250 tpy or more of any regulated pollutant for unlisted sources. The proposed SPM buoy system is not considered a PSD listed source and, therefore, the PSD review threshold is 250 tpy for criteria pollutants.

The proposed SPM buoy system will trigger PSD major source thresholds due to being located in an attainment/unclassifiable area and to VOC emissions exceeding 250 tpy. Once this threshold has been exceeded, emissions of each criteria pollutant are compared against the respective PSD significant emission rate (SER), and emissions of GHGs are compared against the GHG PSD threshold to determine if the project triggers PSD review for other pollutants. Per TCEQ guidance, only emissions from the marine loading operations have been considered in the applicability determination comparison against the PSD major source thresholds. Emissions from the vessel and other ancillary operations have been considered secondary emissions and are not included in the PSD applicability determination.¹⁵ Based on the comparisons, the proposed SPM buoy system will be a major source under PSD for VOCs only.

9.1.2. Nonattainment New Source Review

Nonattainment New Source Review (NNSR) will not apply to the proposed SPM buoy system because the proposed location will be classified as in attainment or unclassifiable for all relevant NAAQS.

9.1.3. New Source Performance Standards

TGTI reviewed each NSPS and found no NSPS regulations that are potentially applicable to the proposed SPM buoy system.

9.1.4. National Emission Standards for Hazardous Air Pollutants

The proposed SPM buoy system will be a major source of HAP as potential emissions are above the HAP major source threshold (potential emissions of HAP are 200 tpy). The proposed SPM buoy system will not be subject to any NESHAP subpart in 40 CFR Part 61.

NESHAP Subpart Y applies to affected sources of Marine Tank Vessel Loading Operations. The following definitions from NESHAP Subpart Y (40 CFR 63.561) are important provisions used to determine what qualifies as an affected source regulated under NESHAP Subpart Y.

***Affected source** means a source with emissions of 10 or 25 tons, a new major source with emissions less than 10 and 25 tons, a new major source offshore loading terminal, a source with throughput of 10 M barrels or 200 M barrels, or the VMT source, that is subject to the emission standards in §63.562.*

***Source(s)** means any location where at least one dock or loading berth is bulk loading onto marine tank vessels, except offshore drilling platforms and lightering operations.*

¹⁵ TCEQ APDG 5881, June 2017

Offshore Loading Terminal means a location that has at least ***one loading berth*** that is 0.81 km (0.5 miles) or more from the shore that is used for mooring a marine tank vessel and loading liquids from shore.”

Loading berth means the loading arms, pumps, meters, shutoff valves, relief valves, and other piping and valves necessary to fill marine tank vessels. The loading berth includes those items necessary for an offshore loading terminal.

The proposed SPM buoy system does not fit the definition of a “loading berth” per the definition set forth in 40 CFR 63.561 since the proposed SPM buoy system will not have loading arms, pumps, meters, shutoff valves, nor relief valves. Additionally, the proposed SPM buoy system does not have a “dock” or any fixed structure resembling a dock structure. Per the Cambridge Dictionary, a dock is defined as “a structure built out over the water in a port along which ships can land to load and unload, or the enclosed area of water between two such structures.”

Therefore the proposed SPM buoy system does not fit the definition of an “affected source” because it does not meet the definition of a “source” as stated in 40 CFR 63.561.

The definitions of “offshore loading terminal” and “loading berth” are essentially circular. Therefore, TGTI also reviewed the NESHAP Subpart Y preamble and technological support documents to determine if there were any sources similar to the proposed SPM buoy system that were considered in the rulemaking. Based on this review, TGTI concluded that there were no similar sources to the proposed SPM buoy system (i.e., SPM buoy systems for directly and completely loading a VLCC for crude oil export) considered in the development of the NESHAP Subpart Y regulations. The proposed SPM buoy system will be a first of its kind for the United States. Export of crude oil was banned in the United States from 1975, following the 1973 OPEC oil embargo, until 2015 to all countries except Canada. Therefore, because of this legal restriction, there could not have been similar sources in operation when NESHAP Subpart Y was developed in 1995 nor when it was reconsidered in 2011.

The proposed SPM buoy system also presents unique technical, environmental, and operational concerns compared to the sources that were considered in the establishment of MACT Subpart Y standards. EPA acknowledged in responses to comments on the 1995 NESHAP Subpart Y rule that the subcategory established for “offshore terminals” could be broken down into additional subcategories based on throughputs, products handled, etc. It did not, however, consider doing so in 1995 because the public comments did not justify additional subcategories. This reinforces TGTI’s conclusion that the proposed SPM buoy system is not an affected source under NESHAP Subpart Y.

The proposed SPM buoy system represents a major source of HAP emissions that is not specifically regulated or exempted from regulation under a standard issued pursuant to section 112(d), section 112(h) or section 112(j) and incorporated in another subpart of part 63 the requirements of 40 CFR 63.40 through 63.44 apply.¹⁶ The regulations contained in 40 CFR 63.40 through 63.44 carry out section 112(g)(2)(B) of the CAA as it relates to a Case-by-Case MACT determination. As such, TGTI has prepared a Case-by-Case MACT determination application in accordance with 40 CFR 63.40 through 63.44 and Section 112(g) of the CAA to demonstrate the proposed control requirements of submerged fill is the maximum achievable control technology for the proposed SPM buoy system. The Case-by-Case MACT application is submitted under separate cover.

¹⁶ 40 CFR 63.40

9.1.5. Title V Operating Permits

40 CFR Parts 70 and 71 require operating permits for major sources of criteria pollutants. Since potential emissions of VOC will exceed the Title V major source threshold of 100 tpy and emissions of HAP exceed the Title V major source threshold of 10 tpy of a single HAP or 25 tpy of aggregate HAP, a Title V permit will be required. Per EPA Regions 6 request, TGTI is including a Title V permit application along with the submittal of the PSD preconstruction permit application. The applicable Part 71 forms have been provided for the Title V application under separate cover.

9.1.6. Compliance Assurance Monitoring

CAM is applicable to certain sources which use add-on control devices to achieve compliance. Since the proposed SPM buoy system will not utilize any add-on control devices, CAM is not applicable.

9.1.7. Title IV Acid Rain Provisions

The proposed SPM buoy system will not operate any units are affected under the Acid Rain Program.

9.1.8. Risk Management Program, Section 112(r)

The proposed SPM buoy system will not store any substances regulated under the RPM.

9.2. STATE REGULATORY REQUIREMENTS

9.2.1. General Application Requirements (30 TAC §116.111)

(1) a completed Form PI-1 General Application signed by an authorized representative of the applicant. All additional support information specified on the form must be provided before the application is complete;

A completed TCEQ Form PI-1 signed by an authorized representative and all additional supporting information as specified on the form are provided in this application.

(2) information which demonstrates that emissions from the facility, including any associated dockside vessel emissions, meet all of the following.

(2)(A) Protection of public health and welfare.

(2)(A)(i) The emissions from the proposed facility will comply with all rules and regulations of the commission and with the intent of the Texas Clean Air Act (TCAA), including protection of the health and property of the public.

TGTI will comply with all rule and regulations of the commission and with the intent of the Texas Clean Air Act (TCAA), including protection of the health and property of the public. A review of potentially applicable rules is provided below.

Chapter 101 – General Rules: The proposed SPM buoy system will be operated in accordance with all applicable requirements in Chapter 101. Specifically, the proposed SPM buoy system will be operated in accordance with the Chapter 101 General Rules relating to circumvention, nuisance, traffic hazard, notification and recordkeeping requirements for emission events and for startup/shutdown/maintenance, sampling and sampling port procedures, emissions inventory requirements, compliance with Environmental Protection Agency Standards, the National Primary and Secondary Ambient Air Quality Standards, inspection fees, emissions fees, and all other applicable General Rules.

Chapter 111 - Control of Air Pollution from Visible Emissions and Particulate Matter: The proposed SPM buoy system will comply with all applicable requirements in Chapter 111.

Chapter 112 – Control of Air Pollution from Sulfur Compounds: The proposed SPM buoy system will comply with all applicable emission limitations, allowable emission rates, monitoring, reporting, and recordkeeping requirements of 30 TAC Chapter 112.

Chapter 113 – Control of Air Pollution from Toxic Materials: Chapter 113 regulates the emission of radionuclides (40 CFR Part 61, Subpart R), municipal solid waste landfills, hospital/medical/infectious waste incinerators, and hazardous air pollutants for source categories (40 CFR Part 63). There will be no emissions of radionuclides from the proposed SPM buoy system. The proposed SPM buoy system is not a municipal solid waste landfill and does not have a hospital/medical/ infectious waste incinerator. Therefore, these sections of the regulation do not apply. Emissions from hazardous air pollutants are regulated under the MACT program, addressed in the discussion of compliance with Chapter 122 in item (2)(F) below.

Chapter 114 – Control of Air Pollution from Motor Vehicles: No motor vehicles will operate at the proposed SPM buoy system. Therefore, the provisions of Chapter 114 do not apply.

Chapter 115 – Control of Air Pollution from Volatile Organic Compounds (VOC): The proposed SPM buoy system will comply with all applicable requirements in Chapter 115 for loading operations.

Chapter 117 – Control of Air Pollution from Nitrogen Compounds: The proposed SPM buoy system will not be located in a county that is subject to the requirements of Chapter 117.

Chapter 118 – Control of Air Pollution Episodes: The proposed SPM buoy system will not be located in a county that is subject to the requirements of Chapter 118.

Chapter 122 – Federal Operating Permits: The proposed SPM buoy system will be a major source of regulated pollutants as defined in 30 TAC Chapter 122. TGTI will submit a Title V Permit application per the requirements of 40 CFR Part 71 per EPA Region 6 request.

(2)(B) Measurement of emissions. The proposed facility will have provisions for measuring the emission of significant air contaminants as determined by the executive director. This may include the installation of sampling ports on exhaust stacks and construction of sampling platforms in accordance with guidelines in the "Texas Commission on Environmental Quality Sampling Procedures Manual."

Emissions from any source addressed in the application will be sampled upon request of the Executive Director of the TCEQ, and sampling ports and sampling platforms will be installed as needed.

(2)(C) Best available control technology (BACT) must be evaluated for and applied to all facilities subject to the TCAA. Prior to evaluation of BACT under the TCAA, all facilities with pollutants subject to regulation under Title I Part C of the Federal Clean Air Act (FCAA) shall evaluate and apply BACT as defined in §116.160(c)(1)(A) of this title (relating to Prevention of Significant Deterioration Requirements).

This permit application demonstrates that the proposed SPM buoy system will utilize BACT for all emissions sources being proposed as part of this permit application.

(2)(D) New Source Performance Standards (NSPS). The emissions from the proposed facility will meet the requirements of any applicable NSPS as listed under 40 Code of Federal Regulations (CFR) Part 60, promulgated by the United States Environmental Protection Agency (EPA) under FCAA, §111, as amended.

The proposed SPM buoy system will not be subject to any NSPS under 40 CFR Part 60.

(2)(E) National Emission Standards for Hazardous Air Pollutants (NESHAP). The emissions from the proposed facility will meet the requirements of any applicable NESHAP, as listed under 40 CFR Part 61, promulgated by EPA under FCAA, §112, as amended.

The proposed SPM buoy system will not be subject to NESHAPs under 40 CFR Parts 61.

(2)(F) NESHAP for source categories. The emissions from the proposed facility will meet the requirements of any applicable maximum achievable control technology standard as listed under 40 CFR Part 63, promulgated by the EPA under FCAA, §112 or as listed under Chapter 113, Subchapter C of this title (relating to National Emissions Standards for Hazardous Air Pollutants for Source Categories (FCAA §112, 40 CFR Part 63)).

The proposed SPM buoy system is potentially subject to NESHAPs under 40 CFR Parts 63 but was determined to not be subject to NESHAP Subpart Y. TGTI has included a case-by-case MACT applicability assessment to demonstrate that the maximum achievable control technology is being applied to the proposed SPM buoy system.

(2)(G) Performance demonstration. The proposed facility will achieve the performance specified in the permit application. The applicant may be required to submit additional engineering data after a permit has been issued in order to demonstrate further that the proposed facility will achieve the performance specified in the permit application. In addition, dispersion modeling, monitoring, or stack testing may be required.

The proposed SPM buoy system will achieve the performance represented in this permit application.

(2)(H) Nonattainment review. If the proposed facility is located in a nonattainment area, it shall comply with all applicable requirements in this chapter concerning nonattainment review.

As discussed earlier in this section, the proposed SPM buoy system is not located in a nonattainment county, NNSR is not applicable.

(2)(I) Prevention of Significant Deterioration (PSD) review.

(2)(I)(i) If the proposed facility is located in an attainment area, it shall comply with all applicable requirements in this chapter concerning PSD review.

(2)(I)(ii) If the proposed facility or modification meets or exceeds the applicable greenhouse gases thresholds defined in §116.164 of this title (relating to Prevention of Significant Deterioration Applicability for Greenhouse Gases Sources) then it shall comply with all applicable requirements in this chapter concerning PSD review for sources of greenhouse gases.

The proposed SPM buoy system is a new major source with respect to the PSD permitting program due to potential emissions of VOCs; therefore, TGTI is submitting this application in order to comply with the PSD new source review requirements in this chapter.

(2)(J) Air dispersion modeling. Computerized air dispersion modeling may be required by the executive director to determine air quality impacts from a proposed new facility or source modification. In determining whether to issue, or in conducting a review of, a permit application for a shipbuilding or ship repair operation, the commission will not require and may not consider air dispersion modeling results predicting ambient concentrations of non-criteria air contaminants over coastal waters of the state. The commission shall determine compliance with non-criteria ambient air contaminant standards and guidelines at land-based off-property locations.

TGTI has conducted air dispersion modeling to demonstrate the ambient air impacts of the proposed SPM buoy system. They have been submitted under separate cover.

(2)(K) Hazardous air pollutants. Affected sources (as defined in §116.15(1) of this title (relating to Section 112(g) Definitions)) for hazardous air pollutants shall comply with all applicable requirements under Subchapter E of this chapter (relating to Hazardous Air Pollutants: Regulations Governing Constructed or Reconstructed Major Sources (FCAA, §112(g), 40 CFR Part 63)).

TGTI will comply will comply with all applicable requirements under Subchapter E of this chapter as related to Section 112(g).

(2)(L) Mass cap and trade allowances. If subject to Chapter 101, Subchapter H, Division 3, of this title (relating to Mass Emissions Cap and Trade Program), the proposed facility, group of facilities, or account must obtain allowances to operate.

This regulation refers to Chapter 101, Subchapter H, Division 3, which applies to facilities in the Houston-Galveston-Brazoria (HGB) ozone nonattainment area. The proposed SPM buoy system will not located in the HGB ozone nonattainment area. Therefore, the provisions of this regulation do not apply.

(b) In order to be granted a permit, amendment, or special permit amendment, the owner or operator must comply with the following notice requirements.

(1) Applications declared administratively complete before September 1, 1999, are subject to the requirements of Division 3 of this subchapter (relating to Public Notification and Comment Procedures).

Not applicable. The permit application will be sent to the TCEQ in 2018.

(2) Applications declared administratively complete on or after September 1, 1999, are subject to the requirements of Chapter 39 of this title (relating to Public Notice) and Chapter 55 of this title (relating to Request for Reconsideration and Contested Case Hearings; Public Comment). Upon request by the owner or operator of a facility which previously has received a permit or special permit from the commission, the executive director or designated representative may exempt the relocation of such facility from the provisions in Chapter 39 of this title if there is no indication that the operation of the facility at the proposed new location will significantly affect ambient

air quality and no indication that operation of the facility at the proposed new location will cause a condition of air pollution.

TGTI will comply with all applicable notice requirements under Chapter 39 and Chapter 55 associated with this permit application.

10. PERMIT FEE AND PROFESSIONAL ENGINEER CERTIFICATION

Per 30 TAC §116.110(f), since the project's capital cost is greater than \$2,000,000, a professional engineer review has been completed and a certification is included.

Per guidance from EPA Region 6, there is no fee associated with a PSD permit application. TGTI has included the TCEQ form and has indicated no fee is required for completeness.

Texas Commission on Environmental Quality
Table 30
Estimated Capital Cost and Fee Verification

I certify that the total estimated capital cost of the project as defined in 30 TAC § 116.141 is equal to or less than the above figure. I further state that I have read and understand Texas Water Code § 7.179, which defines Criminal Offenses for certain violations, including intentionally or knowingly making, or causing to be made, false material statements or representations.

Company Name: Texas Gulf Terminals Inc.

Company Representative Name (*please print*): Denise Rogers

Title: Regulatory Compliance Manager

Company Representative Signature: *Denise Rogers*

Estimated Capital Cost		Permit Application Fee	GHG*/PSD/Nonattainment Application Fee
Less than	\$300,000	\$900 (minimum fee)	\$3,000 (minimum fee)
\$300,000 to	\$25,000,000	0.30% of capital cost	
\$300,000 to	\$7,500,000		1.0% of capital cost
Greater than	\$25,000,000	\$75,000 (maximum fee)	
Greater than	\$7,500,000		\$75,000 (maximum fee)

*A single PSD fee (calculated on the capital cost of the project per 30 TAC § 116.163) will be required for all of the associated permitting actions for a GHG PSD project. Other NSR permit fees related to the project that have already been remitted to the TCEQ can be subtracted when determining the appropriate fee to submit with the GHG PSD application; please identify these other fees in the GHG PSD permit application.

Permit Application Fee (from table above) = \$0 (See Application Narrative) Date: *6/26/2018*

10.2. PROFESSIONAL ENGINEER CERTIFICATION

I directly supervised the engineering work products contained in the Emissions Calculations section and Appendix A and the Federal BACT section.

To the best of my knowledge, the representations made in this document are true and accurate. By affixing my seal below, I submit that the engineering work and calculations performed in the above listed sections were either performed by myself or under my direct supervision, as defined in Section 131.18 of the Texas Engineering Practice Act and in compliance with Title 30 of the Texas Administrative Code, Chapter 116, Section 116.110(f).

PROFESSIONAL ENGINEER CERTIFICATION

Based on the information provided by TGTI, I directly supervised the engineering work products contained in the following sections of this document.

Emissions Calculations

Best Available Control Technology

To the best of my knowledge, the representations made in this document are true and accurate. By affixing my seal below, I submit that the engineering work and calculations performed in the above listed sections were either performed by myself or under my direct supervision, as defined in Section 131.18 of the Texas Engineering Practice Act and in compliance with Title 30 of the Texas Administrative Code, Chapter 116, Section 116.110(f).

Place P.E. Seal below this line

Hung-Ming Sung
Signature

June 26, 2018
Date

Name: Hung-Ming Sung, Trinity Consultants



APPENDIX A: EMISSION CALCULATIONS

Texas Gulf Terminals Inc.
Normal Operations Emission Calculations
Marine Loading (DWP Emissions Source for PSD Applicability)
Criteria Pollutants

Hourly and Annual VOC Emissions Estimates for Loading of Crude Oil and Condensate

Hourly Loading Emissions

Liquid Loaded [1]	Saturation Factor [2]	Maximum Temp [3]		Vapor MW (lb/lb mol)	Maximum True Vapor Pressure (TVP) [4] (psia)	Arrival Emission Factor [5] (lb/1,000 gal)	Generated Emission Factor [6] (lb/1,000 gal)	Uncontrolled Loading Loss [7] (lb/1,000 gal)	TOC to VOC Factor	Hourly Loading Rate [8] (bbl/hr)	Uncontrolled VOC Hourly Emissions [9] (lb/hr)
		(°F)	(°R)								
Crude Oil	0.2	73.50	533.17	50	11.00	--	--	2.57	1.00	60,000	6,478.07
Condensate	0.2	73.50	533.17	60	11.00	--	--	3.08	1.00	60,000	7,773.68

[1] For hourly emission estimates, the worst-case marine loading commodity between Crude oil and Condensate will be utilized.

[2] Saturation factor for marine loading obtained from U.S. EPA 42, Section 5.2 (1/95), Table 5.2-1.

[3] Maximum of monthly average liquid surface temperature was used .

[4] Maximum true vapor pressure for Crude oil and Condensate obtained from information provided by Texas Gulf Terminals

[5] Arrival emission factor for crude/condensate loading obtained from U.S. EPA 42, Section 5.2 (1/95), Table 5.2-3.

[6] Generated emission factor is calculated using equation 3 from U.S. EPA 42, Section 5.2 (1/95).

[7] Uncontrolled Loading Loss (lb/1,000 gal) = 12.46 x Saturation Factor x Maximum TVP of Liquid Loaded (psia) x Vapor MW (lb/lbmol) / Maximum Temperature of Bulk Liquid Loaded (°R)

$$\text{Crude Oil Uncontrolled Loading Loss (lb/1,000 gal)} = \frac{12.46}{1,000 \text{ gal}} \times \frac{0.2}{\text{hr}} \times \frac{11.00 \text{ psia}}{\text{lbmole}} \times \frac{50 \text{ lb}}{533.17 \text{ R}} = 2.57 \text{ lb/1,000 gal}$$

[8] Hourly Loading Rate obtained from information provided by TGTI Revised Design Parameters email from Ms. Denise Rogers (TGTI) to Mr. Brian Burdorf (Trinity Consultants) on February 25, 2018.

[9] Uncontrolled VOC Hourly Emissions (lb/hr) = Uncontrolled Loading Loss (lb/1,000 gal) x Hourly Loading Rate (bbl/hr) x 42 gal/bbl x TOC to VOC Factor x (1/1,000)

$$\text{Crude Oil Uncontrolled Loading Emissions (lb/hr)} = \frac{2.57 \text{ lb}}{1,000 \text{ gal}} \times \frac{60,000 \text{ bbl}}{\text{hr}} \times \frac{42 \text{ gal}}{\text{bbl}} \times \frac{1.00}{1,000} = 6,478 \text{ lb/hr}$$

Texas Gulf Terminals Inc.
Normal Operations Emission Calculations
Marine Loading (DWP Emissions Source for PSD Applicability)
Criteria Pollutants

Annual Loading Emissions

Liquid Loaded [1]	Saturation Factor [2]	Annual Average Temp [3]		Vapor MW (lb/lb mol)	Average True Vapor Pressure (TVP) [4] (psia)	Arrival Emission Factor [5] (lb/1,000 gal)	Generated Emission Factor [6] (lb/1,000 gal)	Uncontrolled Loading Loss [7] (lb/1,000 gal)	TOC to VOC Factor	Annual Loading Rate [8] (bbl/yr)	Uncontrolled VOC Annual Emissions [9] (tpy)
		(°F)	(°R)								
Crude Oil	0.2	73.50	533.17	50	11.00	--	--	2.57	1.00	192,000,000	10,364.91
Condensate	0.2	73.50	533.17	62	9.25	--	--	2.68	1.00	192,000,000	10,807.77

[1] For annual emission estimates, the worst-case marine loading commodity between Crude oil and Condensate will be utilized.

[2] Saturation factor for marine loading obtained from U.S. EPA 42, Section 5.2 (1/95), Table 5.2-1.

[3] Average of monthly average liquid surface temperature was used .

[4] Average true vapor pressure for Crude oil and Condensate obtained from information provided by Texas Gulf Terminals

[5] Arrival emission factor for crude/condensate loading obtained from U.S. EPA 42, Section 5.2 (1/95), Table 5.2-3.

[6] Generated emission factor is calculated using equation 3 from U.S. EPA 42, Section 5.2 (1/95).

[7] Uncontrolled Loading Loss (lb/1,000 gal) = 12.46 x Saturation Factor x Average TVP of Liquid Loaded (psia) x Vapor MW (lb/lbmol) / Average Temperature of Bulk Liquid Loaded (°R)

$$\text{Crude Oil Uncontrolled Loading Loss (lb/1,000 gal)} = \frac{12.46 \times 0.2 \times 11.00 \text{ psia} \times 50 \text{ lb}}{533.17 \text{ R}} = 2.57 \text{ lb/1,000 gal}$$

[8] Annual Loading Rate obtained from information provided by TGTI Revised Design Parameters email from Ms. Denise Rogers (TGTI) to Mr. Brian Burdorf (Trinity Consultants) on February 25, 2018 and June 22, 2018.

[9] Uncontrolled VOC Loading Emissions (tpy) = Uncontrolled Loading Loss (lb/1,000 gal) x Annual Loading Rate (bbl/yr) x 42 gal/bbl x TOC to VOC Factor x (1/1,000) x (1 ton/2,000 lb)

$$\text{Crude Oil Uncontrolled Loading Emissions (tpy)} = \frac{2.57 \text{ lb}}{1,000 \text{ gal}} \times \frac{192,000,000 \text{ bbl}}{\text{yr}} \times \frac{42 \text{ gal}}{\text{bbl}} \times \frac{1.00}{1,000} \times \frac{1 \text{ ton}}{2,000 \text{ lb}} = 10,365 \text{ tpy}$$

Texas Gulf Terminals Inc.
Normal Operations Emission Calculations
Marine Loading (DWP Emissions Source for PSD Applicability)
Criteria Pollutants

Hourly and Annual H₂S Emissions Estimates for Loading of Crude Oil and Condensate

Parameter	Value	Unit
H ₂ S MW	34.1	lb/lbmol
H ₂ S Max Vapor Fraction in Crude oil [1]	2.40E-05	
H ₂ S Max Vapor Fraction in Condensate [1]	2.40E-05	
Maximum Mass Ratio of H ₂ S in Crude Oil [2]	2.19E-05	lb H ₂ S/lb VOC
Maximum Mass Ratio of H ₂ S in Condensate [2]	1.76E-05	lb H ₂ S/lb VOC

[1] Maximum H₂S vapor fraction is assumed to be 24 ppmv for sweet crude.

[2] H₂S Mass Ratio in Crude Oil/Condensate (lb H₂S/lb VOC) = H₂S Vapor Fraction in Crude Oil/Condensate x H₂S MW (lb/lbmole)/Crude Oil/Condensate Vapor MW (lb/lbmole) x 14.7 psia/Vapor Pressure of Crude Oil/Condensate (psia)

$$\text{Max H}_2\text{S Mass Ratio in Crude Oil (lb H}_2\text{S/lb VOC)} = \frac{2.40\text{E-}05}{1\text{bmole}} \times \frac{34.1\text{ lb}}{50\text{ lb}} \times \frac{14.7\text{ psia}}{11\text{ psia}} = 2.19\text{E-}05\text{ lb H}_2\text{S/lb VOC}$$

Liquid Loaded [1]	Maximum TVP [2] (psia)	Uncontrolled VOC Hourly Emissions (lb/hr)	Uncontrolled VOC Annual Emissions (tpy)	H ₂ S Hourly Emissions [3] (lb/hr)	H ₂ S Annual Emissions [4] (tpy)
Crude Oil	11.00	6,478	10,365	0.14	0.23
Condensate	11.00	7,774	10,808	0.17	0.24

[1] For hourly and annual emission estimates, the worst-case marine loading commodity between Crude oil and Condensate will be utilized.

[2] Maximum true vapor pressure for Crude oil and Condensate obtained from information provided by Texas Gulf Terminals

[3] H₂S Hourly Emissions (lb/hr) = Max H₂S Mass Ratio in Crude/Condensate (lb H₂S/lb VOC) x Uncontrolled VOC Hourly Emissions (lb/hr)

$$\text{H}_2\text{S Hourly Emissions from Crude Oil (lb/hr)} = \frac{2.19\text{E-}05\text{ lb H}_2\text{S}}{1\text{b VOC}} \times \frac{7,774\text{ lb}}{\text{hr}} = 0.14\text{ lb/hr}$$

[4] H₂S Annual Emissions (tpy) = Max H₂S Mass Ratio in Crude/Condensate (lb H₂S/lb VOC) x Uncontrolled VOC Annual Emissions (tpy)

$$\text{H}_2\text{S Annual Emissions from Crude Oil (tpy)} = \frac{2.19\text{E-}05\text{ lb H}_2\text{S}}{1\text{b VOC}} \times \frac{10,808\text{ tpy}}{1\text{b VOC}} = 0.23\text{ tpy}$$

APPENDIX B: FEDERAL NSR ANALYSIS TCEQ TABLES



**TABLE 1F
AIR QUALITY APPLICATION SUPPLEMENT**

Permit No.: N/A				Application Submittal Date:							
Company: Texas Gulf Terminals Inc											
RN: 110317666				Facility Location:							
City:				County:							
Permit Unit I.D.:				Permit Name:							
Permit Activity: <input checked="" type="checkbox"/> New Source <input type="checkbox"/> Modification											
Complete for all Pollutants with a Project Emission Increase.				POLLUTANTS							
				Ozone		CO	PM ₁₀	PM _{2.5}	NO _x	SO ₂	Other ¹
				VOC	NO _x						
Nonattainment?											
PSD?				X							
Existing site PTE (tpy)?											
Proposed project emission increases (tpy from 2F ²)?											
Is the existing site a major source?											
If not, is the project a major source by itself?											
If site is major source, is project increase significant?											
If netting required, estimated start of construction:											
5 years prior to start of construction				contemporaneous							
Estimated start of operation				period							
Net contemporaneous change, including proposed project, from Table 3F. (tpy)											
Major NSR Applicable?											
<i>Danar Rogers</i> Signature			<i>Compliance Mgr.</i> Title			10/26/2018 Date					

¹ Other pollutants. [Pb, H₂S, TRS, H₂SO₄, Fluoride excluding HF, etc.]

² Sum of proposed emissions minus baseline emissions, increases only.

The representations made above and on the accompanying tables are true and correct to the best of my knowledge.

APPENDIX C: MEPC.185(59) - GUIDANCE FOR VOC MANAGEMENT PLANS

ANNEX 10

RESOLUTION MEPC.185(59)
Adopted on 17 July 2009

**GUIDELINES FOR THE DEVELOPMENT OF
A VOC MANAGEMENT PLAN**

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(a) of the Convention on the International Maritime Organization concerning the functions of the Marine Environment Protection Committee conferred upon it by international conventions for the prevention and control of marine pollution,

NOTING that the revised MARPOL Annex VI was adopted by resolution MEPC.176(58) which is expected to enter into force on 1 July 2010,

NOTING ALSO that regulation 15.6 of the revised Annex VI requires a tanker carrying crude oil to have onboard and implement a VOC management plan approved by the Administration, and that such a plan shall be prepared taking into account the guidelines developed by the Organization,

HAVING CONSIDERED the draft Guidelines for the development of a VOC management plan prepared by the Sub-Committee on Bulk Liquids and Gases at its thirteenth session,

1. ADOPTS the Guidelines for the development of a VOC management plan, as set out in the Annex to this resolution; and
2. INVITES Governments to apply the Guidelines from 1 July 2010.

ANNEX

GUIDELINES FOR THE DEVELOPMENT OF A VOC MANAGEMENT PLAN

1 Objectives

- .1 The purpose of the VOC management plan is to ensure that the operation of a tanker, to which regulation 15 of MARPOL Annex VI applies, prevents or minimizes VOC emissions to the extent possible.
- .2 Emissions of VOCs can be prevented or minimized by:
 - .1 optimizing operational procedures to minimize the release of VOC emissions; and/or
 - .2 using devices, equipment, or design changes to prevent or minimize VOC emissions.
- .3 To comply with this plan, the loading and carriage of cargoes which generate VOC emissions should be evaluated and procedures written to ensure that the operations of a ship follow best management practices for preventing or minimizing VOC emissions to the extent possible. If devices, equipment, or design changes are implemented to prevent or minimize VOC emissions, they shall also be incorporated and described in the VOC management plan as appropriate.
- .4 While maintaining the safety of the ship, the VOC management plan should encourage and, as appropriate, set forth the following best management practices:
 - .1 the loading procedures should take into account potential gas releases due to low pressure and, where possible, the routing of oil from crude oil manifolds into the tanks should be done so as to avoid or minimize excessive throttling and high flow velocity in pipes;
 - .2 the ship should define a target operating pressure for the cargo tanks. This pressure should be as high as safely possible and the ship should aim to maintain tanks at this level during the loading and carriage of relevant cargo;
 - .3 when venting to reduce tank pressure is required, the decrease in the pressure in the tanks should be as small as possible to maintain the tank pressure as high as possible;
 - .4 the amount of inert gas added should be minimized. Increasing tank pressure by adding inert gas does not prevent VOC release but it may increase venting and therefore increased VOC emissions; and

- .5 when crude oil washing is considered, its effect on VOC emissions should be taken into account. VOC emissions can be reduced by shortening the duration of the washing or by using a closed cycle crude oil washing programme.

2 Additional considerations

- .1 A person in charge of carrying out the plan
 - .1 A person shall be designated in the VOC management plan to be responsible for implementing the plan and that person may assign appropriate personnel to carry out the relevant tasks;
- .2 Procedures for preventing or minimizing VOC emissions
 - .1 Ship-specific procedures should be written or modified to address relevant VOC emissions, such as the following operations:
 - .1 Loading;
 - .2 Carriage of relevant cargo; and
 - .3 Crude oil washing;
 - .2 If the ship is equipped with VOC reduction devices or equipment, the use of these devices or equipment should be incorporated into the above procedures as appropriate.
- .3 Training
 - .1 The plan should describe the training programmes to facilitate best management practices for the ship to prevent or minimize VOC emissions.



IMO

E

Ref. T5/1.01

MEPC.1/Circ.680
27 July 2009

TECHNICAL INFORMATION ON SYSTEMS AND OPERATION TO ASSIST DEVELOPMENT OF VOC MANAGEMENT PLANS

1 The Marine Environment Protection Committee, at its fifty-ninth session (13 to 17 July 2009), approved the Guidelines for the Development of a Volatile Organic Compound (VOC) Management Plan for tankers carrying crude oil (resolution MEPC.185(59)).

2 In conjunction with consideration of the guidelines, MEPC 59 agreed that additional technical information on vapour pressure control systems and their operation would assist the industry in development of VOC management plans. Therefore, MEPC 59 agreed to the technical information on systems and operation to assist development of VOC management plans for tankers carrying crude oil, as set out in the annex to this document.

3 The technical information addresses the general equipment and systems involved, their operation and conditions on board a crude oil tanker with respect to the formation and emission of Volatile Organic Compounds (VOC) as well as the ability to control VOC formation and emissions.

4 Member Governments are invited to bring this circular to the attention of their Administrations, relevant shipping organizations, recognized organizations, shipping companies and other stakeholders concerned and encourage them to take it into account when applying the Guidelines for the development of a VOC management plan for crude oil tankers.

ANNEX

TECHNICAL INFORMATION ON VAPOUR PRESSURE CONTROL SYSTEMS AND THEIR OPERATION TO ASSIST DEVELOPMENT OF VOC MANAGEMENT PLANS FOR TANKERS CARRYING CRUDE OIL

Introduction

This technical information is compiled pursuant to the requirements in MARPOL Annex VI Regulation 15.6, and describes the general equipment, operations and conditions onboard a crude oil tanker with respect to the emission and ability to control Volatile Organic Compound (VOC) emissions.

The Guidelines for the development of a VOC management plan state:

1 Objectives

- .1 The purpose of the VOC management plan is to ensure that the operation of a tanker, to which regulation 15 of MARPOL Annex VI applies, prevents or minimizes VOC emissions to the extent possible.
- .2 Emissions of VOCs can be prevented or minimized by:
 - .1 optimizing operational procedures to minimize the release of VOC emissions; and/or
 - .2 using devices, equipment, or design changes to prevent or minimize VOC emissions.
- .3 To comply with this plan, the loading and carriage of cargoes which generate VOC emissions should be evaluated and procedures written to ensure that the operations of a ship follow best management practices for preventing or minimizing VOC emissions to the extent possible. If devices, equipment, or design changes are implemented to prevent or minimize VOC emissions, they shall also be incorporated and described in the VOC management plan as appropriate.
- .4 While maintaining the safety of the ship, the VOC management plan should encourage and, as appropriate, set forth the following best management practices:
 - .1 the loading procedures should take into account potential gas releases due to low pressure and, where possible, the routing of oil from crude oil manifolds into the tanks should be done so as to avoid or minimize excessive throttling and high flow velocity in pipes;
 - .2 the ship should define a target operating pressure for the cargo tanks. This pressure should be as high as safely possible and the ship should aim to maintain tanks at this level during the loading and carriage of relevant cargo;

- .3 when venting to reduce tank pressure is required, the decrease in the pressure in the tanks should be as small as possible to maintain the tank pressure as high as possible;
- .4 the amount of inert gas added should be minimized. Increasing tank pressure by adding inert gas does not prevent VOC release but it may increase venting and therefore increased VOC emissions; and
- .5 when crude oil washing is considered, its effect on VOC emissions should be taken into account. VOC emissions can be reduced by shortening the duration of the washing or by using a closed cycle crude oil washing programme.

2 Additional considerations

- .1 A person in charge of carrying out the plan
 - .1 A person shall be designated in the VOC management plan to be responsible for implementing the plan and that person may assign appropriate personnel to carry out the relevant tasks;
- .2 Procedures for preventing or minimizing VOC emissions
 - .1 Ship-specific procedures should be written or modified to address relevant VOC emissions, such as the following operations:
 - .1 Loading;
 - .2 Carriage of relevant cargo; and
 - .3 Crude oil washing;
 - .2 If the ship is equipped with VOC reduction devices or equipment, the use of these devices or equipment should be incorporated into the above procedures as appropriate.
- .3 Training
 - .1 The plan should describe the training programmes to facilitate best management practices for the ship to prevent or minimize VOC emissions.

Section 1 – The hull and its pressure limitations

1.1 Allowable cargo tank ullage pressure

1.1.1 The cargo tank structure is designed to withstand a range of design loads and parts of the tank structure will also contribute to the global longitudinal strength of the ship. The classification societies' specified load conditions and loads are applied in verification of the structural design. One such load is the combined pressure from the liquid cargo and the tank ullage pressure. The tank ullage pressure is to be minimum 25 kN/m^2 or the opening pressure of the pressure relief device (P/V valve), whichever is greater. Accordingly, the maximum allowable ullage pressure in a standard tanker is typically interpreted as 25 kN/m^2 (i.e. approximately 2,550 mmWG). It should however be noted that global strength considerations and the impact of other design loads may imply that actual allowable pressure could be higher.

1.1.2 In terms of under pressure, SOLAS regulation II-2/11.6 indicates an allowable under pressure of -700 mmWG. From a structural point of view, the maximum allowable tank under pressure is presumably lower.

1.1.3 Exceeding the maximum allowable pressures could lead to structural failures. If such a structural failure results in opening of the tank structure to atmosphere, uncontrolled VOC emissions will occur together with the possibility of oil pollution to the seas. Further, it could result in loss of inert gas protection with subsequent hazards related to fire and explosion.

1.2 Typical cargo tank venting systems

1.2.1 The design of cargo tank venting and inert gas systems is governed by SOLAS regulation II-2/11.6 and 5. Most crude oil tankers have a common cargo tank venting and inert gas main pipeline which is also used for vapour emission control (ref. section 4). Branches to each cargo tank are provided with isolation valves and blanking arrangements. The isolation valves and blanks are typically only used in connection with tank entry. SOLAS chapter II-2 requires that the isolation valves are to be provided with locking arrangements to prevent inadvertent closing/opening of said tanks. The cargo tank venting/inert gas main is connected to a mast riser. The mast riser has a minimum height of 6 metres with an IMO approved flame arrestor at its outlet. An isolation valve is provided between the cargo tank venting/inert gas main and the mast riser. Some designs have a small capacity pressure/vacuum valve fitted in a bypass across the isolation valve. This latter enables thermal breathing from cargo tanks when the isolation valve is closed. A liquid-filled P/V breaker is typically connected to the cargo tank venting/inert gas main. The P/V breaker has a capacity to accommodate the gas flow from cargo tanks during loading (125% of the loading rate and discharge rate). The cargo tank venting/inert gas main is typically used during loading and discharging operations. During loading the mast riser valve is open (unless vapour emission control is performed) and VOC is expelled to air. During discharge the same valve is closed and inert gas used to replace the tank atmosphere. The cargo tank venting/inert gas main is also used during voyage but the mast riser valve will be operated only in the event of increasing ullage pressure.

1.2.2 In addition to the common cargo tank venting/inert gas main, each cargo tank is required to have a pressure/vacuum relief device for thermal breathing in the event the cargo tank is isolated from the common cargo tank venting/inert gas main. Although classification societies accept that these devices have the capacity to accommodate gas volumes resulting from variations in cargo temperature only (i.e. thermal breathing), latest industry practices have led to the installation of devices with the capacity to accommodate the full gas flow from loading of cargo tanks.

1.3 Typical settings of pressure/vacuum relief devices

1.3.1 Although the design pressure of cargo tanks is typically +2,500 mmWG and -700 mmWG, the typical setting of pressure/vacuum valves on crude tankers is +1,400 mmWG and -350 mmWG.

1.3.2 The typical settings of the P/V breakers are +1,800 mmWG and -500 mmWG. It should be noted that for liquid filled P/V breakers, the settings have to take into account ship movement (rolling and pitching) as specified by the classification societies.

Section 2 – Crude Oil Tanker Pressure control/release systems

2.1 Introduction

2.1.1 Traditionally, vapour release from crude oil tankers occurs on three discrete occasions, they being: during loading, during the loaded voyage to the discharge port, and during the ballasting of cargo tanks at the discharge port.

2.1.2 Since the introduction of the International Convention for the Prevention of Pollution from Ships together with its Protocol in 1978 (MARPOL), tankers built after 1 June 1982 (regulation 18), termed MARPOL tankers, are all designed with the required totally segregated (designated) ballast tanks. With these regulations in force, cargo tanks are never used for the loading of ballast, except on very rare occasions for bad weather purposes where one of the Crude Oil Washed cargo tanks is dedicated to take in ballast water. Therefore, the displacement of vapour from the relevant crude oil cargo tank at the discharge port has ceased to occur for the MARPOL compliant type tankers. Given this situation then, only two occasions remain where vapour emissions from crude oil tankers generally occur, namely on loading and during the transportation of the cargo.

2.2 Load Port Displacement of VOC

2.2.1 Displacement of crude oil cargo vapours at the loading port continues to occur. The reasons for the existence of these volumes of this displaced, but co-mingled¹, vapour must be subdivided and attributed to two discrete tanker operations; namely existing vapour in the cargo tank system before loading and, the evolved vapour created during the loading programme.

2.2.2 The first portion of the vapour displaced from the cargo tanks to be considered is that from the evolved vapour generated during the previous discharge programme and in particular that vapour generated as a result of the Crude Oil Washing of the cargo tanks. The concentration of this proportion of vapour within the co-mingled gas mixture within a cargo tank can be

¹ The vapour emissions on loading are a mixture of hydrocarbon vapours and the inert gas introduced into the cargo tank to achieve a positive pressure within the cargo tank system.

determined prior to commencement of the loading process. The second portion of vapour displaced is that that develops or evolves during the loading programme itself. This vapour evolves as a result of, both, the turbulence generated in the cargo tanks due to the volumetric rate of loading and the pressure differentials within the loading pipeline system creating a degree of “flashing” of the vapour from the incoming crude oil.

2.2.3 To illustrate the extent of these gases within a cargo tank system on a tanker during a loading process, Figure 2.1 below shows the measurements of hydrocarbon vapour concentrations as taken from a tanker during its loading programme. The “X” axis of the graph records the percent status of loading of the tanker whereas the “Y” axis records the percentage of hydrocarbon vapour (VOC) concentration. The graph primarily records the total hydrocarbon gas concentration at the differing percentages of loading of the cargo tanks. However, this total figure is then mathematically proportioned and subdivided, taking into consideration the diminishing size of the vapour volume in the cargo tanks, into the two concentrations of vapours, namely those present at the commencement of loading (in the event approximately 4% of the total tank vapour volume) and the concentration of vapours that evolve as a result of the loading process.

2.2.4 These vapours are displaced by the incoming cargo volumes, throughout the loading period, and released through the ship’s vapour pipeline system (inert gas pipeline) to atmosphere via the ship’s mast riser. In order to prevent excess pressures within the cargo tank system the isolation/control valve to the mast riser is fully opened at the commencement of loading and remains opened until completion of loading. Once the mast riser valve is shut and loading is completed, the necessary “in tank” positive pressure is achieved to prevent any form of air/oxygen entry into the cargo tank vapour system as is required by the SOLAS regulations.

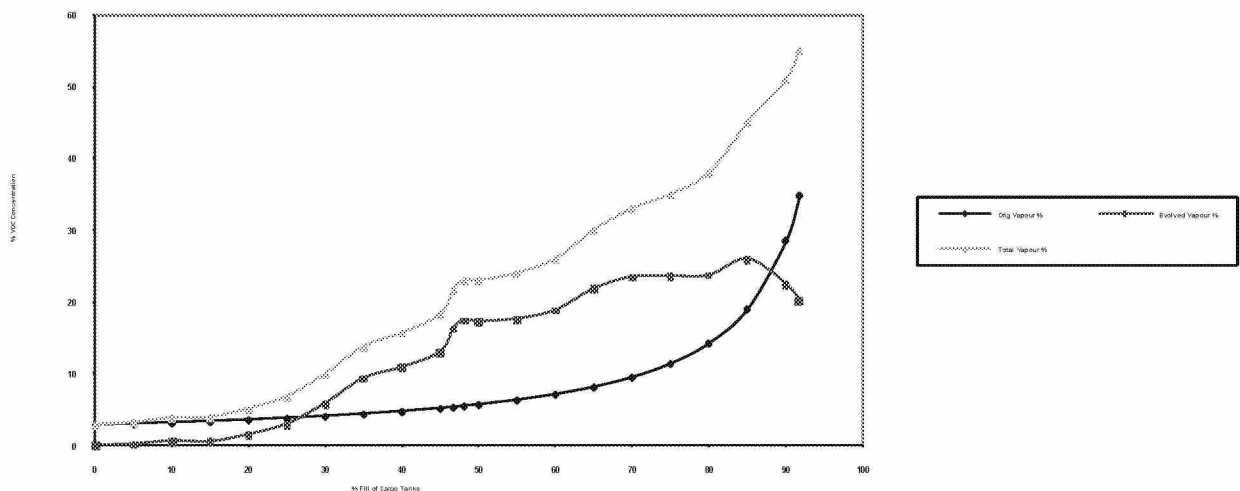


Figure 2.1 – Hydrocarbon vapour concentration in the vapour phase during a loading

2.2.5 In Figure 2.2 below, a photograph shows the deck of a tanker and highlights the relevant pressure control and release mechanisms, namely the vessel's mast riser, the individual tank Pressure/Vacuum (P/V) valves and the secondary safety mechanism of the P/V breaker. These mechanisms will be explained further in this section.

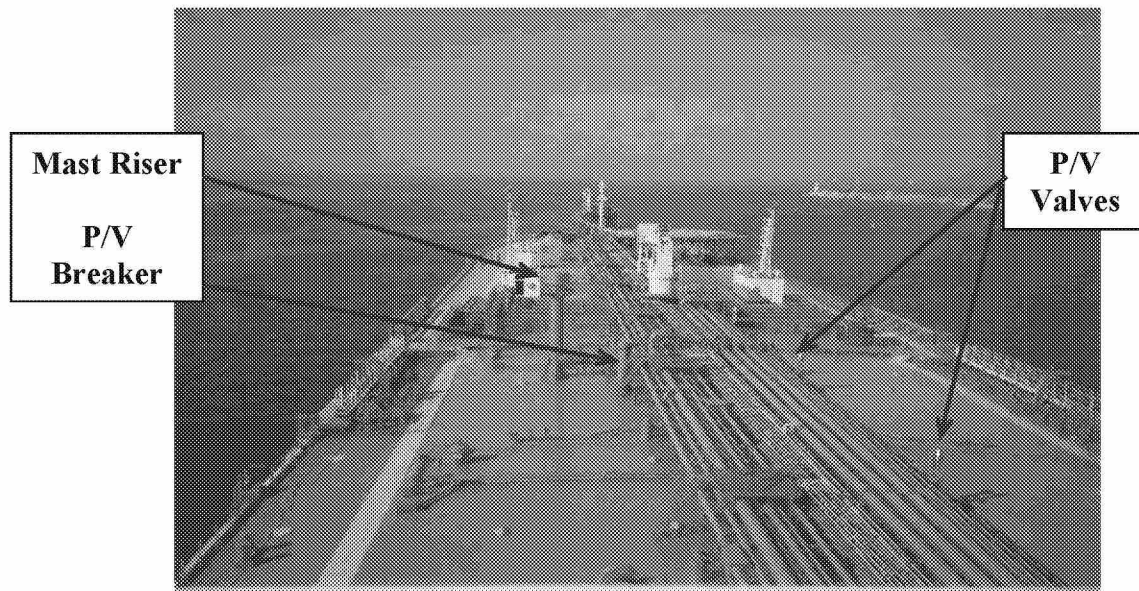


Figure 2.2 – Main Cargo Deck of a Crude Oil Tanker

2.2.6 Typically a normal loading programme will take about 24 hours for a VLCC with a volumetric rate of loading of up to 20,000 m³/hour. The mast riser is normally used during loading for tank vapour pressure control. Its exit location, being at least 6 metres above the deck, allows for the free flow of the vapours displaced from the cargo tanks by the incoming liquid crude oil at the rate of loading of the cargo. The rate of displacement of VOC vapours from the cargo tank system will be the same as the loading rate but the concentration of VOC vapours in the displaced stream will be greater dependent upon the extent and rate of evolution of VOC vapours (vapour growth) from the incoming cargo that would add to the volume of gas/vapour mixture already existent in the cargo tank prior to loading, as shown in Figure 2.1 above.

2.3 VOC release during the voyage

2.3.1 During the voyage, the temperature of the gases/vapours in the ullage space of the cargo tanks and the liquid cargo varies. The gas phase consists of a mixture of unsaturated gases (Inert Gas – for tank safety and protection) and saturated vapours (evolved hydrocarbon vapours from the cargo). The temperature of the gas phase of the tank varies diurnally with its maximum temperature being achieved by mid afternoon and its coolest temperature in the early hours of the morning. The liquid phase temperature varies very much slower and is dependent upon both the hull design and the temperature of the surrounding seawater.

2.3.2 Figure 2.3 below records, as an example, the vapour pressure and cargo temperature data of a reported voyage for a single hulled (but segregated ballast) tanker. The graph records on the “X” axis the days of the voyage whereas the “Y” axis records both the cargo temperature (°C) and the pressure (mmWG) within the vapour phase of the cargo tank system. Superimposed upon the graph is both the normal operational release pressure as well as the P/V valve opening

pressure levels. The vapour pressure readings were recorded every four hours whereas the cargo liquid temperature readings (blue) were recorded daily.

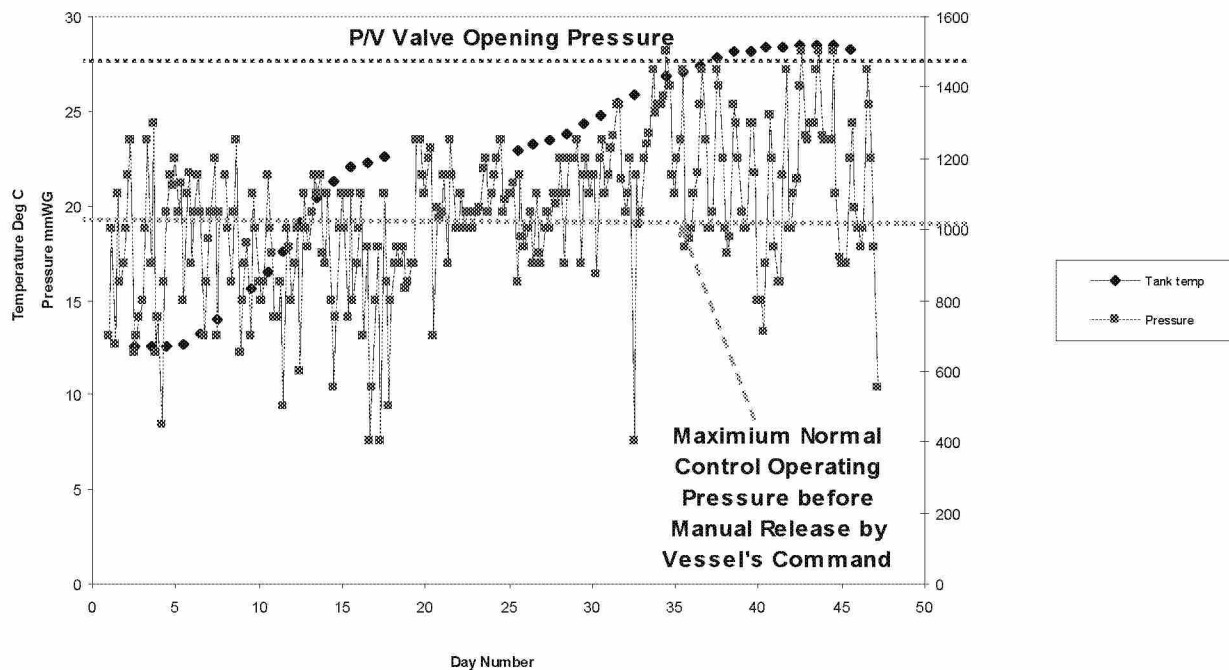


Figure 2.3 – Temperature and Pressure profile for a crude oil voyage

2.3.3 The double hulled construction of a crude oil tanker has a void/ballast space located between the cargo tank and the outer hull, this causes the temperature of the liquid cargo to remain closer to the temperature of the cargo upon loading for a longer period due to the so called “Thermos Effect” or heat loss insulation created by the void or empty ballast space. The cargo temperature profile, as shown in Figure 2.3, reflects the expected changes to temperature for a cargo carried on board a single hulled vessel where the impact of the seawater temperature upon the cargo is more apparent. This aspect can be more clearly seen in Figure 2.3 for the early/interim days of the 47-day voyage from North Sea to the Far East.

2.4 A Crude Oil Tanker’s vapour pressure control mechanisms

2.4.1 A crude oil tanker is designed and constructed to withstand high vapour pressures up to a certain value. In order to protect the vessel’s structure against excessive pressures, two differing levels of safety mechanisms are installed to control and limit the pressures exerted in the vapour phase of the cargo system. The installation of both these systems is a requirement within the International Convention for the Safety of Life at Sea (SOLAS). These mechanisms are:

- .1 the individual tank Pressure/Vacuum (P/V) valve; and
- .2 the common Pressure/Vacuum (P/V) breaker.

2.4.2 The P/V valve is the primary mechanism for the protection from cargo tank over pressure. The design and operational requirements of the P/V valves are set out in the ISO 5364:2000 standard but the opening and closing pressure setting of the individual valves is set in accordance with the designed tolerance of the relevant structure having applied the necessary safety margins.

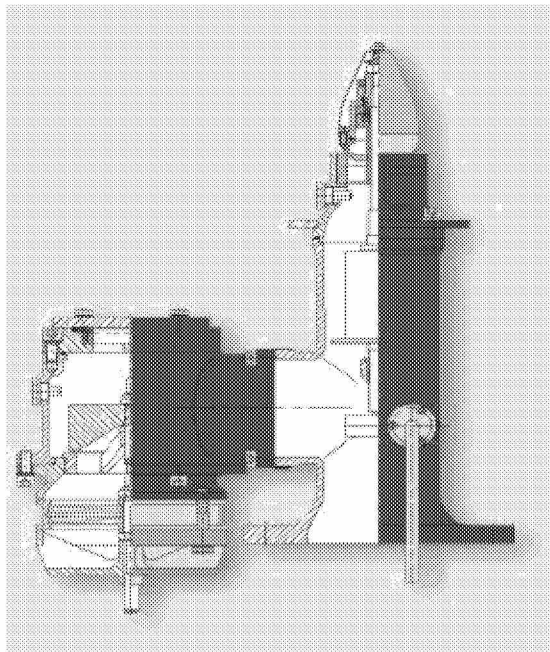


Figure 2.4 – A design and construction of a P/V valve²

2.4.3 A design of a P/V valve may be seen in Figure 2.4 above. The valve is fitted to a vertical pipeline connected directly to the vapour space of a cargo tank (see Figure 2.2 above). The valve consists of two sections, namely the vacuum protection section on the left hand side of the valve as shown and the pressure control mechanism of the right hand side. Both mechanisms rely upon a weighted diaphragm that will be lifted when the pre-designed pressures are met. On the pressure side of the valve the exit nozzle is designed such that the exit velocity of the vapours reach the required velocity so as to maintain the deck working area clear of hydrocarbon vapours.

2.4.4 Each cargo tank is normally equipped with its valve so that full protection is available, should the individual cargo tank be isolated from the main common vapour system on board the tanker. The typical pressure setting for a P/V valve is traditionally measured in millimetres of water gauge and would be in the range from 1,400 to 1,800 mmWG. These valves are supported on a connecting pipeline to the tank's atmosphere by a 100 to 150 mm diameter pipeline and located at least 2 metres above the deck. Due to the requirements to prevent mechanical damage to these valves the closing pressure is controlled by a damping mechanism (to prevent hammering of the valve). As a result of the damping mechanism the closing pressure of the valve will vary but will be in the range of 400-800 mmWG.

² Courtesy Pres-Vac Engineering A/S: www.pres-vac.com.

2.4.5 Supporting the over pressure safety system of the P/V valve is the secondary safety mechanism of the P/V breaker. In the event of a rapid pressure fluctuation within the common vapour system the P/V breaker is available to relieve such an over pressure. The single P/V breaker is located on the common vapour pipeline, serving all the cargo tank branch pipelines, which ends at the vessel's mast riser (see Figure 2.2).

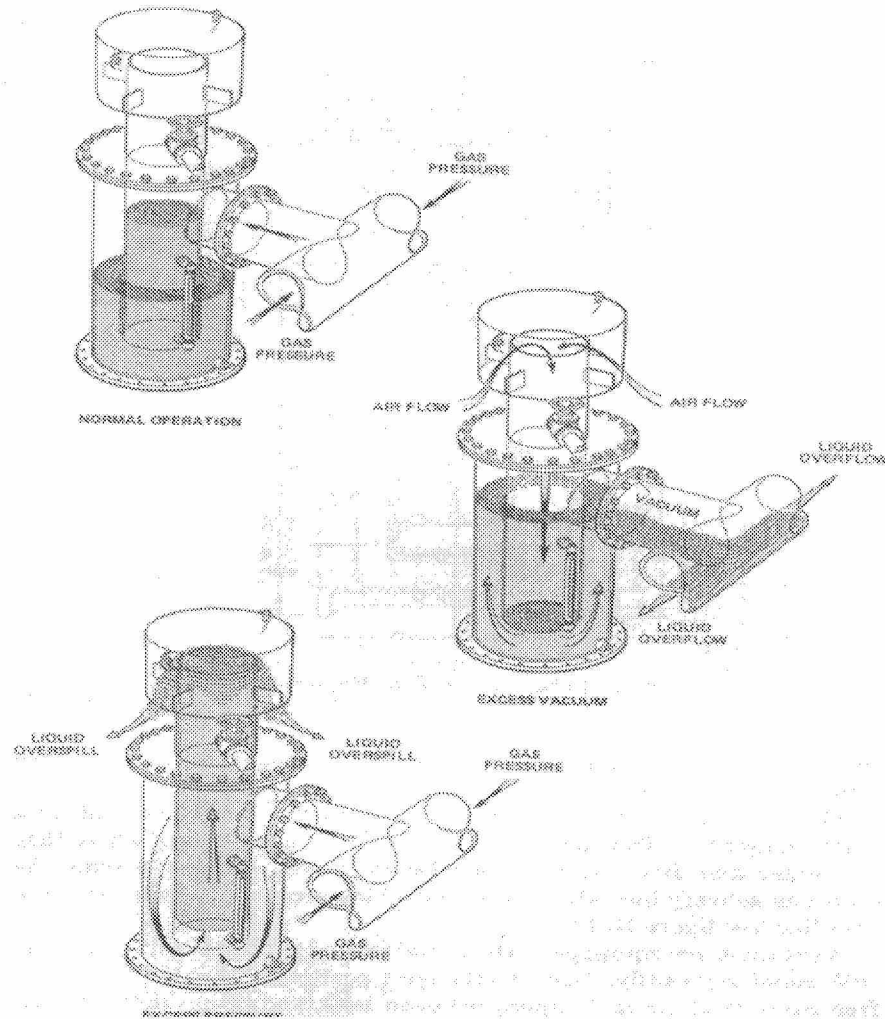


Figure 2.5 – The design and operation of a P/V breaker³

2.4.6 The construction and operation of the P/V breaker may be seen in Figure 2.5 above. The pressure setting in the P/V breaker is achieved by way of the internal water column with an equivalent pressure setting of approximately 2,000 mmWG. The water column also isolates the vapour phase from external air ingress into the system. In the event of an excessive pressure surge within the tank vapour system the water column would either be displaced out of the breaker onto the deck, in the event of excessive pressure, or drawn into the cargo tanks in the event of an under pressure. This will, therefore, open the total vapour system to the external environment and atmospheric pressure and, due to the equipment's dimensions, will relieve the pressure in the system very quickly. Thus, this safety mechanism, due to its pressure setting, will only operate if the vessel tank's P/V valves fail to operate or are not of sufficient capacity to relieve the pressure surge adequately.

³ Reference – G.S. Marton, Tanker Operations – a Handbook for Ship's Officers, page 76.

2.4.7 It should, however, be noted that once the P/V breaker operates then, as stated above, it will reduce the pressure within the tank vapour system to atmospheric pressure, thereby exposing the tank system to ingress of oxygen. Therefore, this system is a “last resort” system to preserve the structure of the tanker from damage.

Section 3 – VOC generation systems in Crude Oil

3.1 Why limit VOC Emissions to the atmosphere? VOCs are a pollutant to the air and act as a precursor to the formation of Tropospheric Ozone – commonly termed Smog.

Thus, to control this emission, there are four criteria that impact on the extent and rate of evolution of gaseous VOC from crude oils and its subsequent release to atmosphere. These are:

- .1 the volatility or vapour pressure of the crude oil;
- .2 the temperature of the liquid and gas phases of the crude oil tank;
- .3 the pressure setting or control of the vapour phase within the cargo tank; and
- .4 the size or volume of the vapour phase within the cargo tank.

Each of these criteria are defined and briefly explained below together with any interaction between the criteria for general operational circumstances.

3.2 The volatility or vapour pressure of the crude oil

3.2.1 Reid Vapour Pressure (RVP) – this is an industrially developed standard test method to determine the Air Saturated absolute Vapour Pressure of volatile, non-viscous hydrocarbon liquids in compliance with the requirements specified in the Institute of Petroleum test procedure IP 69.

3.2.2 The RVP is the vapour pressure obtained within a standardized piece of test equipment for the evolved hydrocarbon vapour at a temperature of 100°F or 37.8°C. The standard test parameters for the determination of this pressure are important to identify and relate to the ratio of a fixed liquid volume to a fixed vapour volume. This ratio is one part liquid to four parts vapour. Thus, the pressure reported for this parameter reflects, in principle, the pressure that would be registered when the cargo tanks are about 20% loaded.

3.2.3 This leads to the importance of two other parameters, namely the Saturated Vapour Pressure and Unsaturated Vapour Pressure. These two parameters, and the physics behind them, give more clear indications and guidance with respect to a crude oil’s volatility with respect to vessel operations and VOC control.

3.2.4 Saturated Vapour Pressure (SVP)⁴ – is the equilibrium pressure generated by the liquid phase for the vapour volume within a defined system. The Saturated Vapour Pressure is developed only by the evolved hydrocarbon vapours from the crude oil liquid phase. For a Saturated Vapour to be present it must have contact with its own liquid phase. If the liquid phase temperature

⁴ An empirical equation exists to correlate the Reid Vapour Pressure (psia) to the Saturated Vapour Pressure of a crude oil at the constant temperature of 37.8°C. This equation is: $P = (6.2106 \cdot \ln P_R) + 4.9959$; Where P is the Saturated Vapour Pressure (psia) at 37.8°C and P_R is the Reid Vapour Pressure (psia) at the same temperature.

increases or decreases so will the Saturated Vapour Pressure vary accordingly – an increase the liquid temperature will cause an increase in the Saturated Vapour Pressure.

3.2.5 However, if the vapour volume increases or decreases for a known liquid temperature, the pressure should, in theory, remain constant (for further understanding on this parameter see paragraph 3.5.2 below). These circumstances, respectively, will only cause the vapour to condensate and fall back to the liquid phase or more vapour to evolve from the liquid phase to maintain the Saturated Vapour Pressure. This physical characteristic is indicative of equilibrium pressure – between the liquid and vapour phases within the defined system.

3.2.6 From the foregoing it can be readily recognized that Saturated Vapour Pressure should not vary with the size of the vapour volume and will only vary with the temperature of the liquid phase – not the vapour phase temperature.

3.2.7 Unsaturated Vapour Pressure (UVP) – contrary to the concept of Saturated Vapour Pressure, an Unsaturated Vapour is not in contact with its liquid phase. In this case the vapour is obtained from other sources such as air or, more likely, Inert Gas. Thus, by reference to the standard laws of physics and what is termed the Ideal Gas Law⁵, both variations in volume and/or temperature (this time it is the gas or vapour phase) will vary the pressure within a closed system.

3.2.8 From an operational perspective this type of behaviour is the primary cause of the variation of pressures within a cargo tank system over a 24-hour period and is to be associated with the Inert Gas phase within a cargo tank. However, the pressure generated from this type of gas/vapour is not the total vapour pressure in the cargo system.

3.2.9 Behind the pressure generated from the Unsaturated Vapours (Inert Gas) lies the pressure generated by the Saturated Vapours (the hydrocarbon vapours evolving from the crude oil cargo). As stated above, this pressure will remain as a constant for a given cargo/liquid temperature and, as is well recognized, a cargo temperature will not vary to the same extent as the vapour temperature due to heating or cooling from external sources (sunlight, sea temperature, air temperature, etc.). Thus, the variation for the tank observed Total Vapour Pressure is due to the presence of Inert Gas in the cargo tank.

3.2.10 Total Vapour Pressure – this pressure is the total pressure to be achieved within a defined closed system given the variable parameters of vapour volume and the differing control temperatures. In fact it is the combination or addition of the Saturated and Unsaturated Vapour Pressures (Dalton's Law of Partial Pressure⁶) within a closed and defined system.

3.2.11 Thus, on board a tanker, the pressure measured within Vapour System is the Total Vapour Pressure of the system which is the sum of the two individual pressures generated by the differing types of gases present in the system.

⁵ The Ideal Gas Law equation is $PV = nRT$ or $P = (nRT)/V$ where: P = Pressure, T = Temperature, V = Volume and nR are gas constants.

⁶ Dalton's Law of Partial Pressure states that "The pressure of a mixture of gases is the sum of the partial pressures of its constituents".

3.3 The temperature of the crude oil in a cargo tank

3.3.1 The measurement and determination of temperature upon the two differing phases in a crude oil cargo tank have differing impacts upon the size and extent of pressure exerted at any one time in the cargo tank. In this regard it is necessary to consider the two phases separately with regard to the impact of temperature.

3.3.2 The temperature of the liquid in a crude oil cargo tank – the temperature of the liquid phase in a crude oil cargo tank will vary little over the period of a voyage unless cargo heating is being undertaken. It is this temperature that determines the Saturated Vapour Pressure that will be exerted by the evolving VOCs from the cargo volume and contribute to the Total Vapour Pressure in the cargo tank at any one time. The cooler the liquid phase temperature the lower will be the Saturated Vapour Pressure of the crude oil but care should be taken not to allow cooling of waxy cargoes too much, such that it promotes wax precipitation.

3.3.3 The temperature of the vapour or gas in a crude oil cargo tank – the temperature of the gas phase in a cargo tank will change more rapidly and vary during the day/night cycle. As this phase in the cargo tank contains a mixture of Saturated (evolved hydrocarbon gases) and Unsaturated (Inert gas) gas species the pressure in this space will vary with temperature due to the reaction of the Unsaturated Gas component to temperature (Ideal Gas Law⁵). Thus, during the day when the gas phase warms, the pressure in the tank will increase so long as there is an Inert Gas component in the gas phase. The obverse will occur at night as the gas phase cools.

3.4 The pressure setting or control of the vapour phase within the cargo tank

3.4.1 The technologies available on board crude oil tankers for the control of pressure within the cargo tank vapour system are discussed in section 2. However, it is important to identify the significance of pressure with respect to the evolution of hydrocarbon vapours from a crude oil liquid phase.

3.4.2 Control of the extent of the pressure within a crude oil cargo tank vapour system will determine the extent of further vapour evolution from a crude oil cargo. If the pressure within the system is controlled at the Saturated Vapour Pressure of the cargo, then equilibrium pressure between the liquid and vapour phase is obtained and no further VOC will evolve from the cargo. However, if the vapour pressure in the crude oil tank vapour system is reduced to a pressure below the Saturated Vapour Pressure of the cargo, then VOC will evolve to restore the equilibrium balance in the system.

3.5 The size or volume of the vapour phase within the cargo tank system

3.5.1 The size or volume of the gas or vapour phase in the cargo tank system (usually a common system on a crude oil tanker due to the interconnection through the Inert Gas pipeline system) is an important criterion to establish the pressure within the system. Again separate consideration should be given to the two differing types of gases to be found in the vapour phase and how volume may impact these component gases.

3.5.2 Saturated vapours from the crude oil liquid phase, as described above in paragraph 3.2.2, under theoretical conditions the pressure generated by saturated vapours will not be affected by a change in the volume space occupied by the vapours. However, due to the numerous species of hydrocarbon types to be found in evolved vapour from a crude oil it has been found that a volumetric change of the vapour phase from a 2% volume (V:L ratio of 0.02) to a 20% volume

(V:L ratio 0.2) will impact the saturated vapour pressure of a crude oil at a constant temperature. For vapour volumes greater than 20% of the total volume the pressure behaves similar to that expected of a Saturated Vapour; namely nearly isobaric. These circumstances can be seen in Figure 3.1 below for a selection of crude oil types.

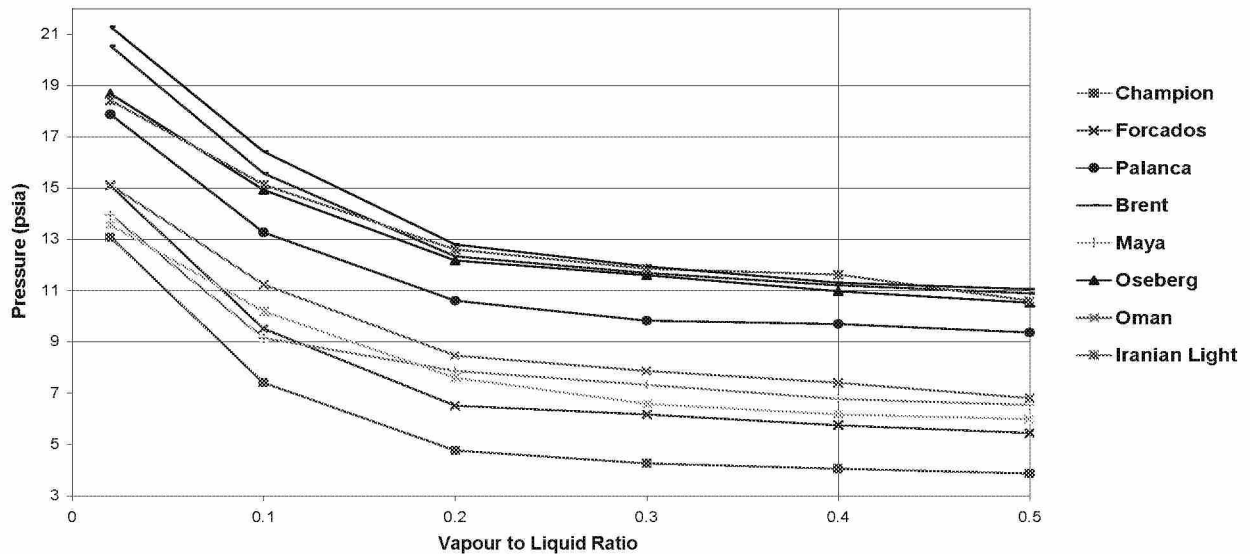


Figure 3.1

3.5.3 The change in pressure with respect to volume, for a vapour percent volume from 2% to 20%, for complexed vapour phases evolved from crude oils, is due to the influence of the individual volatile hydrocarbon types and their varying proportions in both the liquid and vapour phase that separately contribute to the final saturated vapour pressure under equilibrium conditions. The ratio of concentration of the individual hydrocarbon compounds in the vapour phase is due to the *Partition Coefficients* for each hydrocarbon type in relation to another type. This will cause a differing distribution of hydrocarbon species to that in the liquid phase when the vapour phase volume is smaller.

3.5.4 Unsaturated gases (Inert Gas) in the vapour phase system – this type of gas behaves in a manner simulated by the Ideal Gas Law equation⁵. Therefore any reduction in the volume occupied by this gas will cause an increase in the pressure exerted by the gas at a known temperature.

Section 4 – Methods and systems for the control VOC

In this section, examples of methods and systems for the control of VOC are provided.

4.1 Methods and systems for the control of VOC during Loading

4.1.1 Best Practices and design

- .1 Manual pressure relief procedures (tank pressure control);
- .2 P/V valve condition and maintenance;
- .3 Condition of gaskets for hatches and piping;

- .4 Inert gas topping up procedures;
- .5 Partially filled tanks;
- .6 Loading sequence and rate; and
- .7 Use of vapour return manifold and pipelines when shore facilities are available.

4.1.2 Vapour Emission Control Systems

The principle behind VECS is that VOC generated in cargo tanks during loading is returned to the shore terminal for processing, as opposed to being emitted to atmosphere through the mast riser.

Vapour Emission Control Systems (VECS) were introduced in 1990 as a requirement for tankers loading oil and noxious liquid substances at terminals in the United States (USCG 46 CFR Part 39). IMO followed up with the introduction of IMO MSC/Circ.585 "Standards for vapour emission control systems" in 1992. International regulation requiring vapour emission control was introduced through regulation 15 of MARPOL Annex VI adopted in 1997, although it is only required for ships loading cargo at terminals where IMO has been informed that VECS is mandatory.

Since 1990, most crude tankers have installed a VECS system in compliance with USCG regulations. The regulations cover both the technical installation (vapour recovery piping and manifold, vapour pressure sensors and alarms, level gauging, high level and independent overflow alarms) as well as operational restrictions and training. The operational restrictions are found in a mandatory VECS manual which also includes maximum allowable loading rates. The maximum allowable loading rate is limited by one of the following:

- .1 the pressure drop in the VECS system from cargo tank to vapour manifold (not to exceed 80% of the P/V valve setting);
- .2 the maximum pressure relief flow capacity of the P/V valve for each cargo tank;
- .3 the maximum vacuum relief flow capacity of the P/V valve for each cargo tank (assuming loading stopped while terminal vacuum fans are still running); and
- .4 the time between activation of overfill alarm to relevant cargo tank being full (min. 1 minute).

The calculations are to be based on maximum cargo vapour/air densities as well as maximum cargo vapour growth rates, which again may limit the cargoes that can be loaded with VECS.

Further, the calculations are to be carried out both for single tank and multiple tank loading scenarios.

The USCG regulations also contain additional requirements to vapour balancing, i.e. for tankers involved in lightering operations. These include operational requirements as well as technical requirements for an in-line detonation arrestor, oxygen sensors with alarms and possibly means to prevent hazards from electrostatic charges.

For ships provided with a VECS system as per IMO or USCG regulations, the control of VOC emissions will be through returning VOC to the shore terminal in accordance with the procedures found in the onboard VECS manual.

The maximum allowable loading rates and corresponding maximum vapour/air densities and vapour growth rates should be specified in the VOC management plan.

4.1.3 Vapour Pressure Release Control Valve (VOCON valve)

The VOCON valve operates as a hydraulically controlled valve that controls the closing pressure for the valve and therefore undertakes a similar procedure to the manual VOCON procedure as described in 4.2.2 below. However, for the loading programme, the valve also allows a higher pressure to be maintained throughout the loading process in order to limit the extent of vapour evolution from the crude oil once saturated vapour pressure is achieved within the tank vapour system. This valve is normally a single valve facility and located at the bottom of the mast riser by way of a by-pass pipeline to the mast riser control valve. The relevant closing pressure setting for the valve may be done locally or remotely in the Cargo Control Room depending upon the sophistication of the installed system.

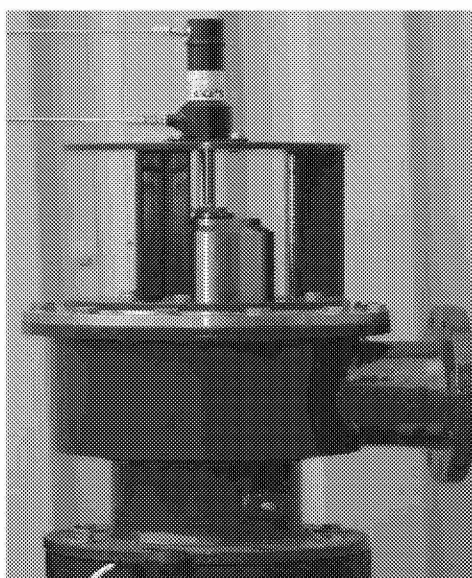


Figure 4.1 – Hydraulically controlled VOCON valve

Similar valves with fixed pressure arrangements are to be found and are currently installed on tankers and located at the same position; namely at the bottom of the mast riser by way of a by-pass pipeline to the mast riser control valve. These valves operate as a form of “tank breather” valve but release vapour through the mast riser.

4.1.4 Cargo Pipeline Partial Pressure control system (KVOC)

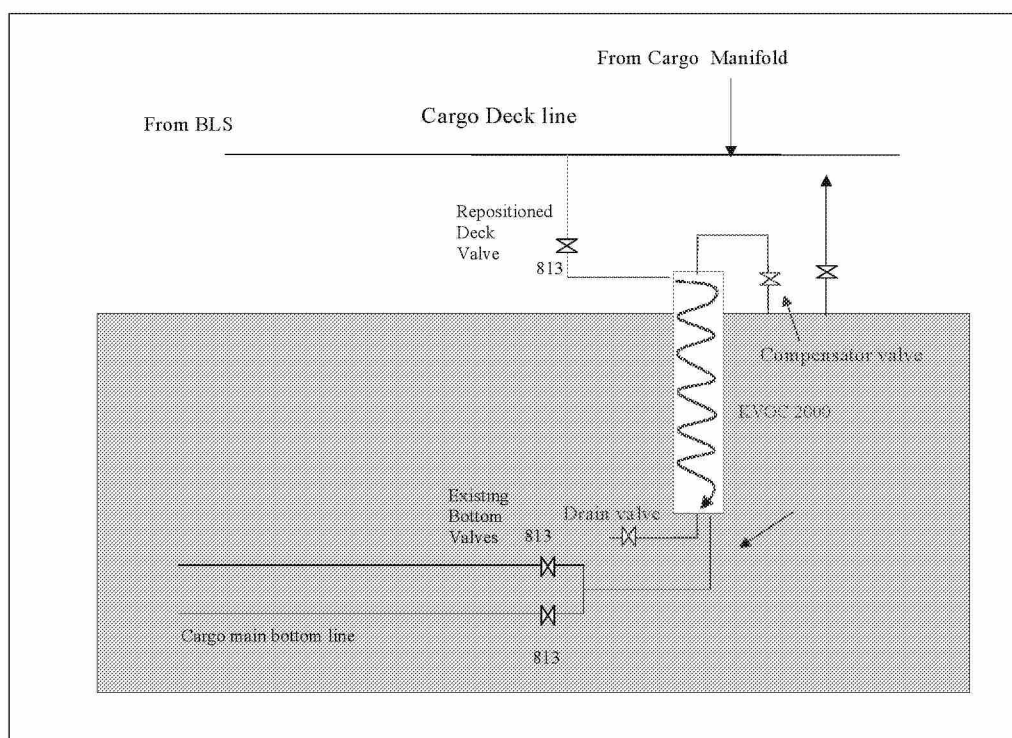
The purpose of the KVOC system installation is to minimize VOC release to the atmosphere by preventing the generation of VOC during loading and transit. The basic principle of KVOC is to install a new drop pipeline column specially designed for each tanker with respect to expected loading rate. The new drop pipeline column will normally have an increased

diameter compared to an ordinary drop line. The increased diameter will reduce the velocity of the oil inside the column and by that means ensure that the pressure adjusts itself to approximately the boiling point of the oil independent of the loading rate. In the initial phase of the loading process some VOC might be generated. The pressure inside the column will adjust itself to the SVP of the oil so that there is a balance between the pressure inside the column and the oil SVP. When this pressure has been obtained in the column the oil will be loaded without any additional VOC generation. This means that KVOC column prevents under pressure to occur in the loading system during loading.

The KVOC system is not designed to remove all VOC, but to minimize generation of VOC. VOC remaining in the tanks from the last cargo and COW operations has to be displaced from the cargo tanks when loading. Also, if the oil boiling point (SVP) is higher than the tank pressure, some crude oil will generate VOC in the tanks and additional VOC be released. Bad weather together with very volatile oil will also increase the VOC emissions due to its SVP also when KVOC is applied.

The KVOC column has an effect on the VOC release during transit, because gas bubbles have been prevented from forming. This means that the amount of gas bubbles in the oil available for release during transit will be minimized. To further reduce the release of VOC, the pressure in the cargo tanks should be held as high as possible. A high pressure, from about 800 to 1,000 mmWG, will reduce possible boiling and diffusion of VOC in the crude oil cargo tanks.

KVOC has also shown a similar effect on H₂S as on minimizing VOC generation. If the KVOC system has been installed, it should therefore always be used when loading sour crude to minimize H₂S concentration in the void spaces and release during loading and transit.



Pipeline Flow Plan for KVOC

4.1.5 Increased pressure relief settings (*Applicable also for transit conditions*)

As described in sections 2 and 3, as long as the tank pressure is maintained above the Saturated Vapour Pressure of the cargo, then equilibrium is obtained between the liquid and vapour phase of the cargo and no further VOC will evolve from the cargo. This means that if the pressure/vacuum relief settings are increased to, e.g., 2,100 mmWG, VOC will not evolve from a cargo as long as the Saturated Vapour Pressure of said cargo is below the pressure relief setting.

As indicated earlier, the maximum design pressure of a cargo tank is at least 2,500 mmWG and, as such, increasing the settings of the pressure/vacuum devices up to, e.g., 2,100 mmWG, should not require additional strengthening. It will however require adjustment/replacement of P/V valves. Note that for some P/V valves designs, the pressure after initial opening increases, and this has to be taken into account if an owner intends to increase the setting of P/V valves.

Needless to say it will also require replacement/modifications to the P/V breaker, as well as water loops serving the inert gas deck water seal, as well as settings of pressure sensors and alarms in the inert gas and VECS system. It is of course also essential that onboard operational procedures in terms of manual pressure release have to be adjusted.

One additional benefit is that increasing the pressure/vacuum relief settings will increase the acceptable loading rate during VECS.

Although the primary benefit of increasing set pressure will occur during voyage. It will also have an effect related to loading, as the increased set pressure will limit the existing vapour in the cargo tanks, i.e. the vapour generated during the previous discharge and Crude Oil Washing.

For ships that have been provided with increased pressure relief settings, the VOC emissions will be controlled when the saturated vapour pressure of the crude oil is below that of the pressure relief valve settings.

It is important that terminals and cargo surveyors acknowledge that if ships with higher pressure settings are required to de-pressurize prior to cargo handling operations, this will limit the ships' ability to control VOC emissions.

4.1.6 Vapour recovery systems – General

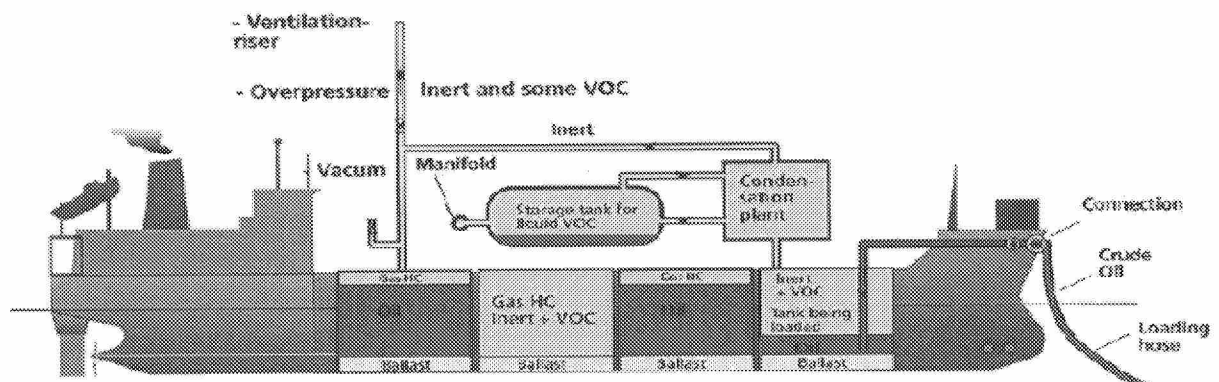
In the late 1990s certain Administrations required offshore installations to reduce their emissions of VOC and this led to the development and installation of vapour recovery systems on board shuttle tankers in the North Sea. Different concepts were developed for the purpose of reducing the emissions of VOC (VOC). The initial efficiency requirement was set to 78% (i.e. 78% less VOC emissions when using vapour recovery systems). The systems can recover VOC in all operational phases.

For ships that have been provided with vapour recovery systems, the VOC emissions will be controlled when the recovery plant is in operation.

The VOC recovery plant efficiency as well as any operational limitations related to, e.g., applicability for different cargo handling modes (loading, transit, COW), maximum allowable loading rates or crude vapour pressures, are to be specified in the VOC management plan.

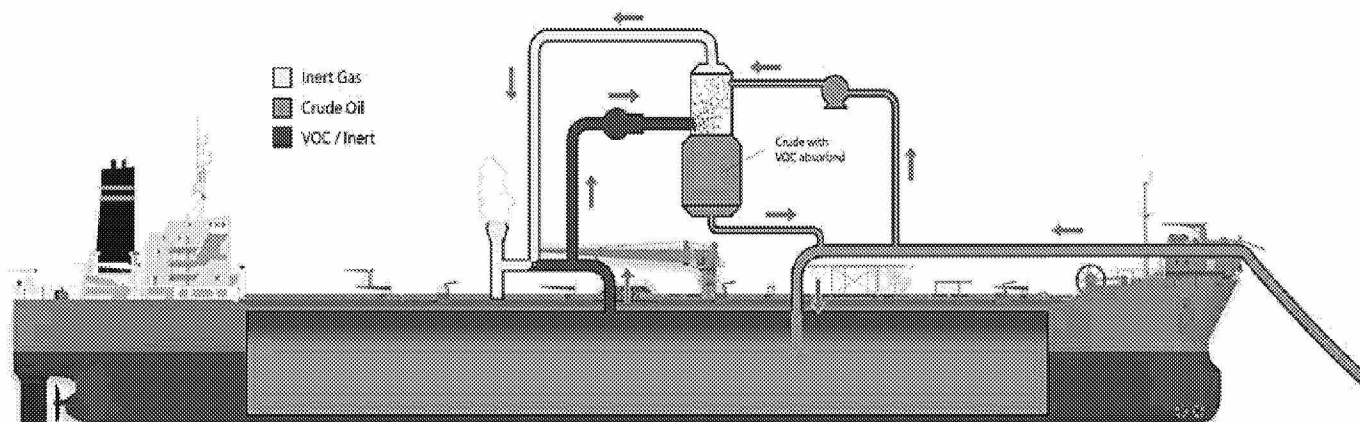
4.1.6.1 Vapour Recovery Systems – Condensation Systems

The principle is similar to that of re-liquefaction plants on LPG carriers, i.e. condensation of VOC emitted from cargo tanks. In the process, the VOC passes through a knock out drum before it is pressurized and liquefied in a two stage process. The resulting liquefied gas is stored in a deck tank under pressure and could either be discharged to shore, or be used as fuel (possibly including methane and ethane) for boilers or engines subject to strict safety requirements. It is also conceivable that the stored gas could be used as an alternative to inert gas subject to the Administration's acceptance.



4.1.6.2 Vapour Recovery Systems – Absorption Systems

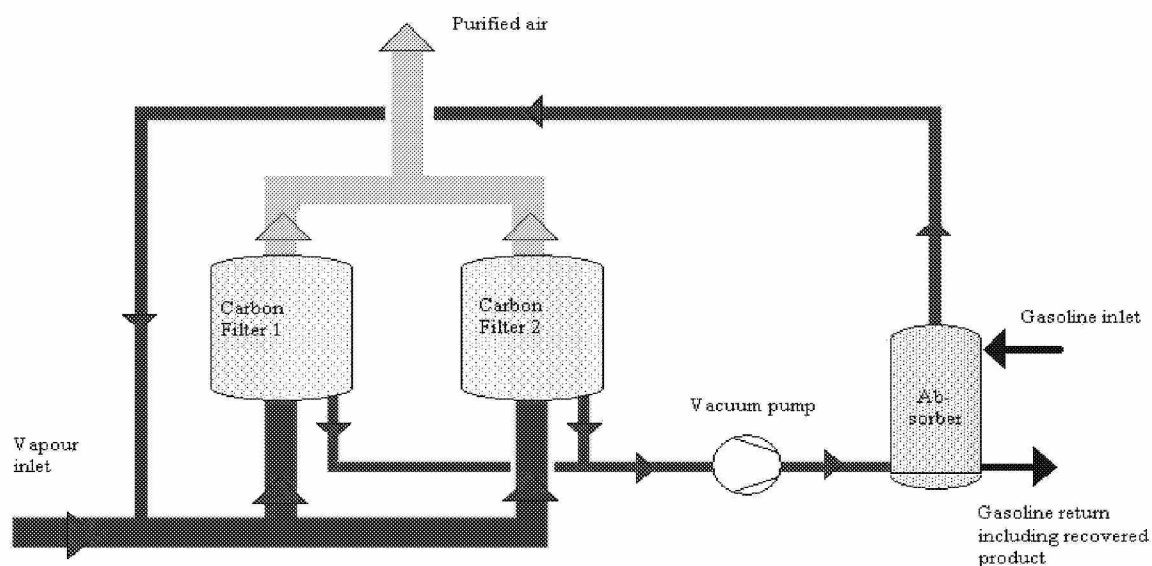
The technology is based on the absorption of VOCs in a counter-current flow of crude oil in an absorber column. The vapour is fed into the bottom of the column, with the side stream of crude oil acting as the absorption medium. The oil containing the absorbed VOC is then routed from the bottom of the column back to the loading line where it is mixed with the main crude oil loading stream. Oil pumps and compressors are used to pressurize the oil and gas. Unabsorbed gases are relieved to the riser to increase the recovery efficiency. Similar concepts have been developed using swirl absorbers instead of an absorption column.



4.1.6.3 Vapour Recovery Systems – Absorption Carbon Vacuum-Regenerated Adsorption

In the CVA process, the crude oil vapours are filtered through active carbon, which adsorbs the hydrocarbons. Then the carbon is regenerated in order to restore its adsorbing capacity and adsorb hydrocarbons in the next cycle. The pressure in the carbon bed is lowered by a vacuum pump until it reaches the level where the hydrocarbons are desorbed from the carbon. The extracted, very highly concentrated vapours then pass into the absorber, where the gas is absorbed in a stream of crude oil taken from and returned to the cargo tanks.

As carbon bed adsorption systems are normally sensitive to high concentrations of hydrocarbons in the VOC inlet stream, the VOC feed stream first passes through an inlet absorber where some hydrocarbons are removed by absorption. The recovered VOC stream may be reabsorbed in the originating crude oil in the same inlet absorber.



4.2 Methods and systems for the control of VOC during Transit

4.2.1 Best Practices/Design

- .1 Manual pressure relief procedures (tank pressure control);
- .2 P/V valve condition and maintenance;
- .3 Condition of gaskets for hatches and piping;
- .4 Inert gas topping up procedures;
- .5 Partially filled tanks;
- .6 Loading sequence and rate; and
- .7 COW procedures (closed cycle⁷).

4.2.2 VOCON procedure

By reference to Figure 4.2 below, this procedure requires the monitoring and the recording of the pressure drop during a release of gas from the cargo tank vapour system. This can be undertaken with the use of the Inert Gas pressure gauge in the cargo control room or, as available, located on the Inert Gas pipeline on deck. Figure 4.2 shows a pressure drop profile using the mast riser and the inflection in the pressure drop where the mast riser valve should be shut.

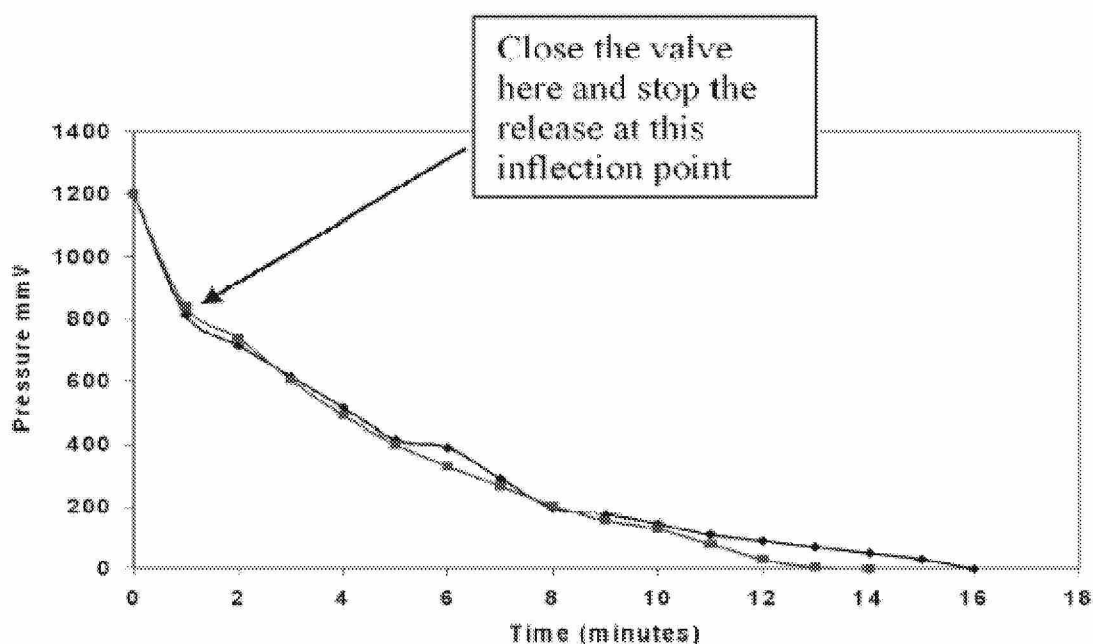


Figure 4.2 – A mast riser release

⁷ “Closed Cycle” crude oil washing means that the tanker’s slop tank is used as the reservoir for the crude oil wash stock and this wash stock is stripped or cycled back to the slop tank for reuse. Thus, using a defined volume of crude oil for washing of the specified cargo tanks will limit the amount of VOC associated with the wash stock volume as distinct from using fresh crude oil throughout the washing programme.

The VOCON operational procedure

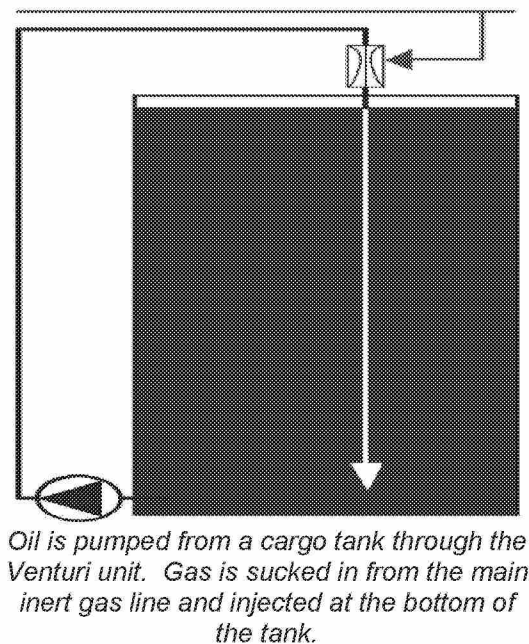
- (1) Before opening the mast riser, note the pressure in the Inert Gas pipeline system.
- (2) Open the pressure release valve and record/monitor the pressure within the Inert Gas pipeline at regular short intervals (every 30 seconds for a mast riser release).
- (3) Plot the pressure drop profile. This can be achieved either manually or by use of the Inert Gas Oxygen and Pressure Recorder in the Cargo Control Room but an increase in the Recorder paper feed rate will be required to achieve definition of the plot.
- (4) When the rate of pressure drop becomes constant (after the initial rapid pressure drop) then the gas release should be stopped and the valve closed.
- (5) Monitor the Tank Gas Pressure after completion of the controlled release in order to check the final pressure obtained within the Vapour/Inert Gas system.

Advice Notes

- (A) A review of Figure 4.2 shows a clear change in the rate of pressure drop during the release period. If the gas release continues after this point then the pressure in the Inert Gas system will be quickly restored to the pressure associated with the point where the rate of pressure drop changes.
- (B) If there is a straight line drop of pressure observed and no inflection observed by 800 mmWG, then close the release valve anyway.
- (C) By reference to the ISGOTT Publication, all safety measures should be taken to minimize the hazards associated with vented gases from the vessel's cargo tank system.

4.2.3 Recovery of excess VOC and tank absorption (Venturi system)

The Venturi system involves a process where evolved VOC is reabsorbed back into the cargo. The system typically consists of a pressure controlled pump, feeding oil to a unit with Venturi(s). The Venturi draws VOC, H₂S and inert gases (IG) from the common cargo tank venting/inert gas main line. The Venturi unit is designed to generate a bubble size optimal for their collapse in the crude oil cargo and rapid absorption. Released near the tank bottom, the soluble compounds are kept dissolved by the pressure head there. Inert gas will eventually surface.



For ships that have been provided with a Venturi type system, the VOC emissions will be controlled when the system is in operation.

The VOC control system efficiency as well as any operational limitations related to, e.g., applicability for different cargo handling modes (loading, transit, COW), maximum allowable loading rates or crude vapour pressures, are to be specified in the VOC management plan.

4.3 Methods and systems for the control of VOC during Discharging/Ballasting

Emissions of VOC during ballasting had relevance when tankers took ballast into cargo tanks for stability and longitudinal strength reasons and thus displaced VOC from cargo tanks being ballasted. After the implementation of requirements to segregated ballast tanks and, of course, double hull, VOC releases during discharge and ballasting are no longer an issue.

During discharging of cargo tanks, it is important that pressure monitoring is exercised in order to avoid excessive supply of inert gas to cargo tanks.

Section 5 – The Monitoring and Control of VOC Releases

5.1 Record keeping is necessary in order to document compliance with the requirements of the management plan and, potentially, the extent of release of gases from the crude oil cargo tanks. The form of record keeping is dependent upon the specific form of method used to minimize the emission of VOC from the crude oil cargo. It will also be dependent upon the operation being performed by the ship necessitating the release of VOC, namely loading during the carriage or as a result of a crude oil washing (COW) operation.

5.2 As a general example of the type and scope of record keeping to be undertaken on board the crude oil tanker, the methodology of the manual VOCON procedure is used. The appropriate record keeping is as follows:

- .1 The target or minimum pressure within the tank gas/vapour system for the specific voyage
 - .1.1 A record of the time and pressure within the tank gas/vapour system before the release takes place.
 - .1.2 A record of the time and pressure within the gas/vapour system after the release has been completed.

5.3 The foregoing data and information may be compiled by the ship's management company or operators in order to assess or quantify the extent or degree of VOC release. As an outline to such assessment the following can be taken into consideration:

- .1 For those ships operating with manual VOC control by the VOCON procedure, the released volume of gas/vapour can be estimated by use of the pressure change (opening to closing pressures) relationship to the total gas/vapour volume in the cargo tank vapour system (Ideal Gas Laws – reference to section 3).

Section 6 – Training Programme

6.1 A training programme is to be developed for the persons intended to assume overall charge of the VOC management on board each ship. The programme is to include the following:

- .1 An introduction to the purpose of VOC emission control:
 - .1.1 Volatile organic compounds (VOCs) may be toxic, and when they evaporate into the air they can react with Nitrogen Oxides (NO_x) in sunlight and split apart oxygen molecules in air and thereby form ground-level ozone, commonly referred to as smog. The layer of brown haze it produces is not just an eyesore, but also is a source of serious illnesses. Ozone is extremely irritating to the airways and the lungs, causing serious damage to the delicate cells lining the airways. It contributes to decreased lung function, increased respiratory symptoms and illnesses.
 - .1.2 Regulation 15 of MARPOL Annex VI
- .2 An introduction to the principles of VOC emission control:
 - .2.1 VOC generation systems in crude oil (ref. section 3)
 - .2.2 Crude oil tanker pressure control/release systems (ref. section 2)
- .3 General VOC emission control options:
 - .3.1 Methods and systems for the control of VOC emissions (ref. section 4)
- .4 Ship specific VOC emission control options:
 - .4.1 Ship specific methods and systems for the control of VOC emissions (ref. section 4)

- .5 Monitoring and recording of VOC release:
 - .5.1 Methods for monitoring and recording of VOC emissions (ref. section 5)
- .6 Hazards and Safety related to VOC emission control:
 - .6.1 The hull and its pressure limitations (ref. section 1)
 - .6.2 Personnel safety hazards related to exposure to crude oil vapour.

Section 7 – Designated Person

7.1 A person should be designated to assume overall charge of the VOC management on board the ship.

The designated person should preferably have:

- .1 At least one year's experience on crude oil tankers where his or her duties have included all cargo handling operations relevant to VOC management. In the absence of experience with VOC management, he or she should have completed a training programme in VOC management as specified in the VOC management plan;
- .2 participated at least twice in cargo loading operations, Crude Oil Washing Operations and transit where VOC management procedures have been applied, one of which should be on the particular ship or a similar ship in all relevant aspects, for which he or she is to undertake the responsibility of VOC management; and
- .3 full knowledge of the contents of the VOC management plan.

Section 8 – List of drawings

8.1 The following drawings are recommended included as appendices to the management plan:

- .1 General Arrangement drawing;
- .2 Tank plan;
- .3 Schematic drawing(s) of the Cargo tank venting system;
- .4 Schematic drawing of the inert gas system;
- .5 Schematic drawing of the vapour emission control systems (if applicable);
- .6 Schematic drawing(s) Vapour Recovery System or other VOC control systems; and
- .7 Details of pressure vacuum relief devices including settings and capacities.

References:

- .1 Vapour Emission Control System manual (if applicable);
 - .2 Vapour Recovery System manual (if applicable);
 - .3 Other VOC control system manual (if applicable);
 - .4 Inert Gas manual; and
 - .5 COW manual.
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